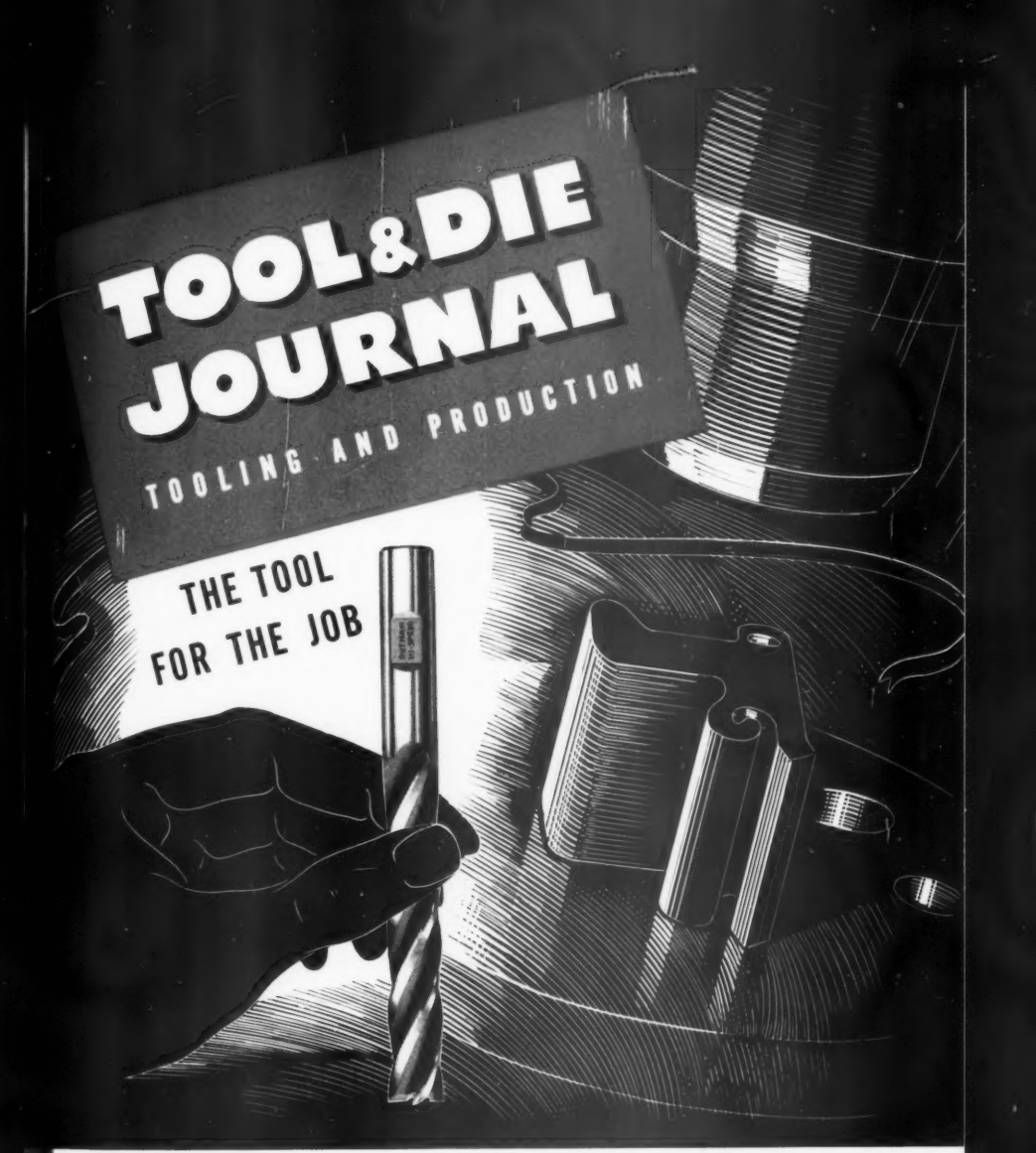

CONTOUR MILLING WITH A PUTNAM END MILL

END MILLS AVAILABLE FROM STOCK

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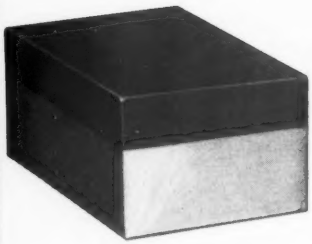
ARMY E NAVY
AWARDED AUGUST 15, 1942

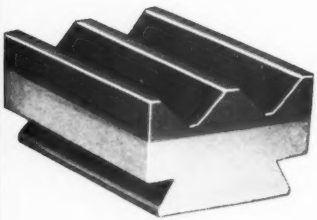
An intricate shape . . . a deep cut . . . this is a job for a Putnam Hi-Speed End Mill. Putnam End Mills are correctly designed and made of the best high speed steel. No matter how tough the job, try a Putnam End Mill. You will learn for yourself that they *do* cut faster and last longer.

PUTNAM TOOL COMPANY
2985 Charlevoix Avenue • Detroit, Michigan

MAY, 1943 • 20,100 COPIES

NEW WAY TO CONSERVE HIGH SPEED STEEL





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1. Non-hardenable, tough base minimizes tendency to crack and break out at sharp dovetail corners and screw holes during heat treating or when working.

2. Easier to drill and tap screw holes and machine dovetails in mild steel base; this work may be done *after* hardening if desired.

3. More prompt delivery because of reduced amount of high speed steel.

4. Inseparable bond between cutting face and base assured by special technique of electric welding.

5. *Marked saving of strategically important tungsten.*

QUALITY FCC SERVICE

THE FORGING and CASTING CORPORATION

FERNDALE (DETROIT) MICHIGAN

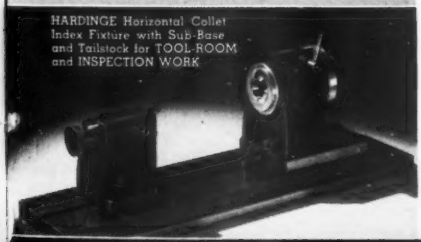
HARDINGE

HARDINGE Horizontal-Vertical Collet Index Fixture with Sub-Base and Tailstock for PRODUCTION WORK

SPECIFICATIONS

Take standard 1" capacity 5C HARDINGE Collets. Available with either a 20 or 24 hole hardened and ground index plate. The sub-base is 24-½" x 5-⅛".

COLLET INDEX FIXTURES



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These fixtures are for direct application or for use with the sub-base on your milling machines, grinders, shapers and drill presses. The index head shown above with sub-base and tailstock can be used in a horizontal or vertical position, the index plate has preselector screws so that holes not required for a particular job can be "blinded". The lever facilitates chucking of work on a production basis.

Ask for complete bulletin.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR

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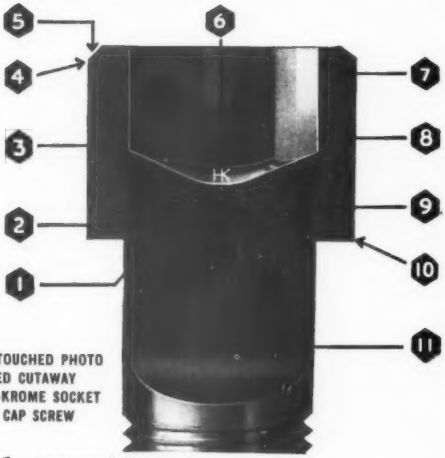
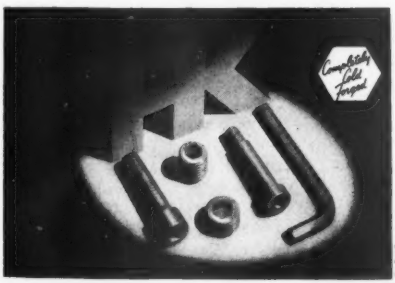


UNRETOUCHED PHOTO ETCHED CUTAWAY HOLO-KROME SOCKET HEAD CAP SCREW



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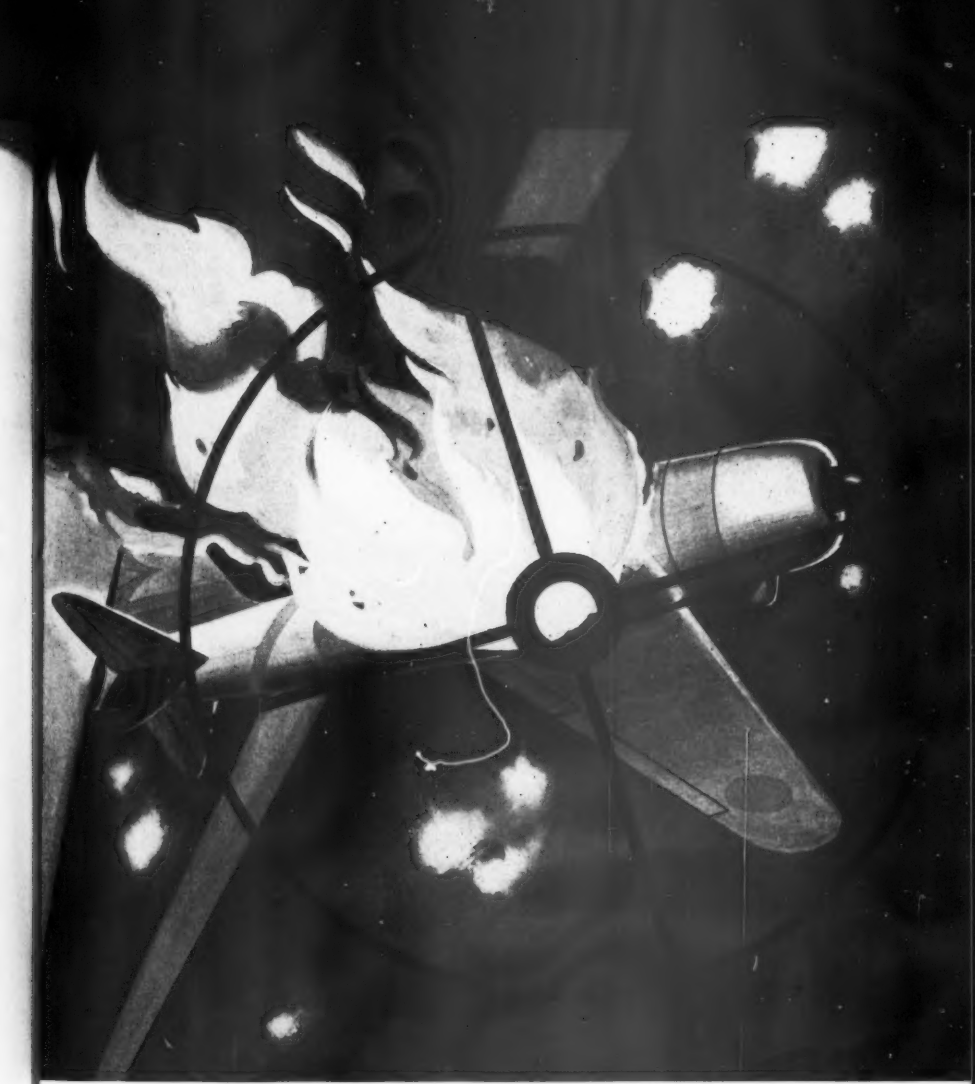

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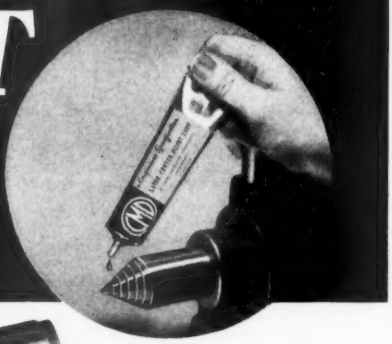

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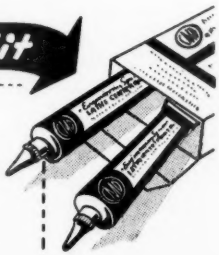

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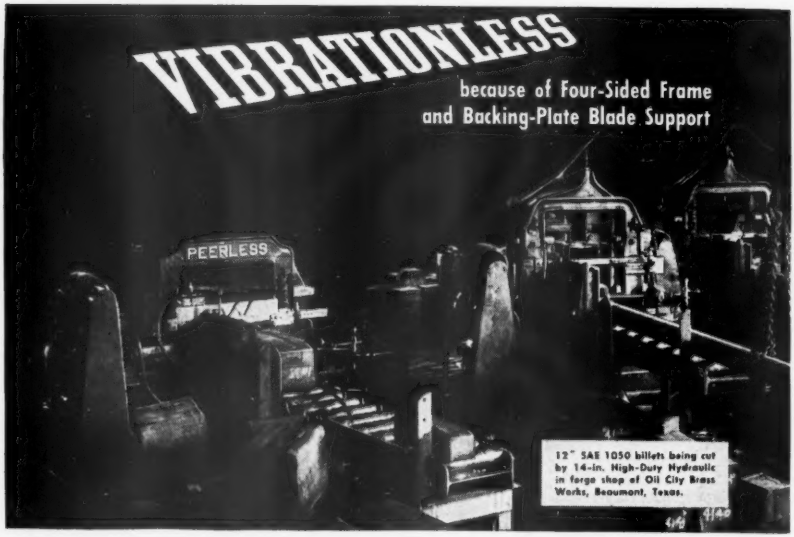
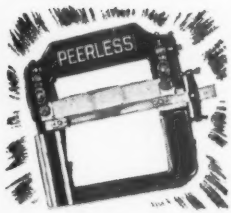

VIBRATIONLESS
because of Four-Sided Frame
and Backing-Plate Blade Support
PEERLESS
12" SAE 1050 billets being cut by 14-in. High-Duty Hydraulic in forge shop of Oil City Brass Works, Beaumont, Texas.

PEERLESS *BLADE CONTROL* ASSURES PRECISION CUTTING AT HIGHER SPEEDS . . .



Four-Sided Frame is distortion-proof and surrounds the blade and the work. Backing-Plate Blade Support gives rigidity to blade assembly. Eight bearings, with hardened and ground inserts, absorb all vibration. This combination of features is found only in Peerless Metal Cutting Saws.

Even when cutting tubing or pipe, Peerless Metal Cutting Saws cut faster, with no hogging, less waste of material and less blade wear. Cutting SAE 1050 billets and other stock, Peerless will average from 5 to 7 sq. in. per minute and the blade is good for 2000 sq. in. When working stainless or aluminum alloys, the fact that as little as 1/16 in. of material is cut away, results in minimum waste of stock.

The vibrationless performance of Peerless Metal Cutting Saws assures *faster precision cutting* at lower cost. Mail the coupon for estimate of cutting time for your toughest job.

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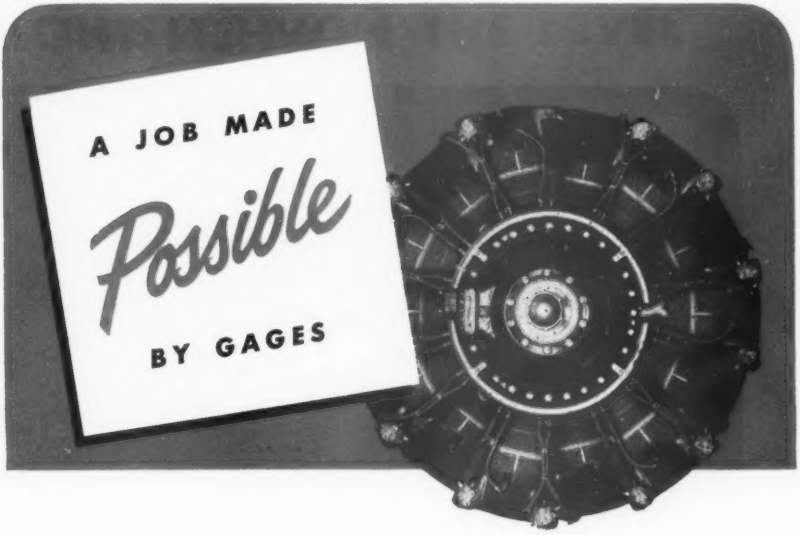
WITH FOUR-SIDED SAW-FRAME AND BACKING-PLATE

Fast ACCURATE Sawing DEMANDS PEERLESS BLADE CONTROL



America needed more aircraft engines —many more!

The automobile industry, with its knowledge of precision manufacture and mass production methods, was selected to help build them.

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Without the gages, the job could not have been done!

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PM special gages—tailored to exact specification —usually require a favorable priority. PM standard gages in wide variety are carried in stock, for immediate shipment.

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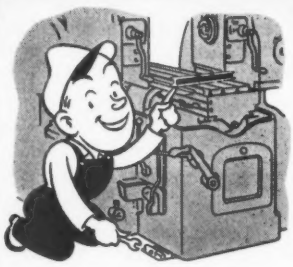
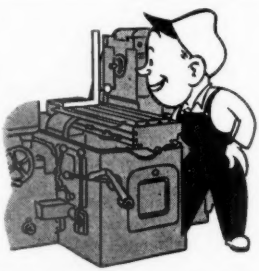


Level the machine periodically. It's easier to do and longer lasting when machine is mounted on leveling blocks.



Check the headstock level accuracy by "tramming", with indicator gage fastened to spindle nose.

CINCINNATI

THE CINCINNATI MILLING MACHINE CO.

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FELLOWS ARE ON THE LEVEL

They'll Cut Straight . . .

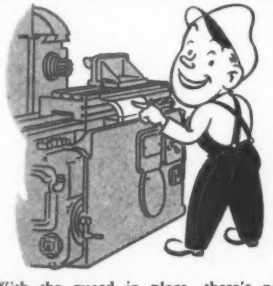
The principal reason why large milling machines do not cut straight is because of inadequate foundations and lack of attention to periodic and accurate releveling. True enough, once the machine is installed, the operator or department supervisor can do little about the foundation, but they *can relevel the machine periodically.* And it's so easy to do. The little fellow at the bottom, in the first two illustrations, shows you how it's done on CINCINNATI Hydromatic Milling Machines.

There are other factors, too, in keeping your Hydromatic running continuously while turning out a high volume of accurate work.

1. ***Level the machine periodically.*** Once every six months should do the job. Leveling blocks should be used for all but the smallest machines.
2. ***Follow lubricating instructions.*** A lubricating schedule tag tied to the machine serves as a convenient reminder.
3. ***Use clean containers for the oil,*** especially oil for the hydraulic unit.
4. ***Clean the hydraulic oil filter.*** Once or twice a month should be sufficient.
5. ***Keep the guard in place over the feed trip plunger.*** This will help prevent accidents; will keep grit and coolant out of feed trip mechanism.
6. ***Loosen quill clamping nut*** before making quill adjustments.

The above routine is just as easy to follow as it looks. Try it—give the machine a chance to make a production record equal to your attendance record.

With a small wrench, the hydraulic oil filter may be cleaned in a few seconds. Do this at least once a month.



With the guard in place, there's no chance for the operator to get his fingers caught between the table dogs and trip plunger

CINCINNATI GRINDERS INCORPORATED CINCINNATI, OHIO, U.S.A.

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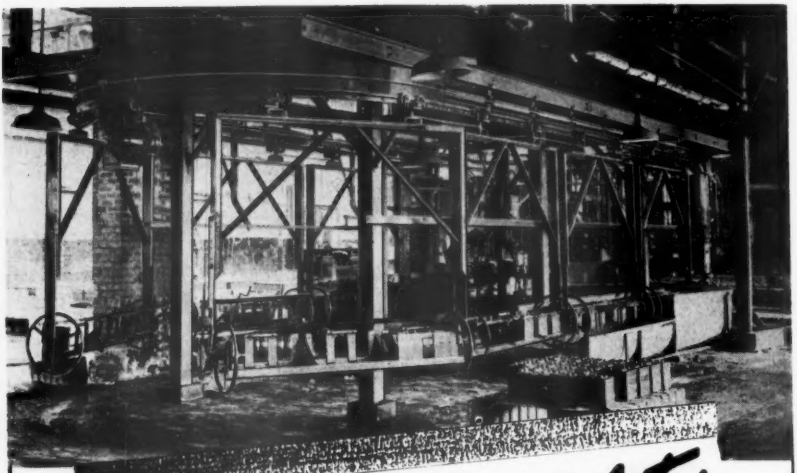

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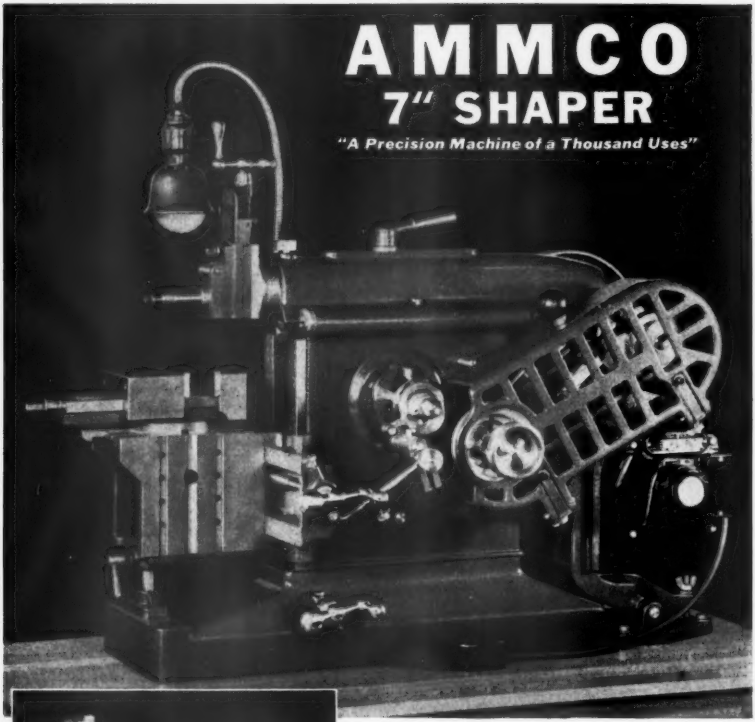

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. . . with NEW FEATURES not found in Grinders costing many times as much

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Specially Designed Column — of one-piece construction. Steel gib guides bracket yoke so it is always in perfect alignment. Entire column, together with bracket, can be rotated 360°. Has many other im portant new features.

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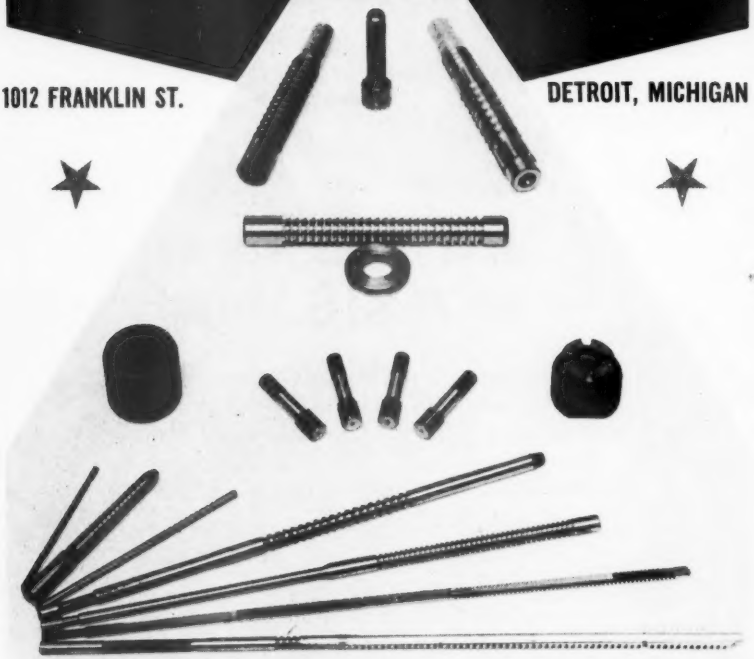

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in production of the tools that safeguard the accuracy of American Industry . . .

We, at The Lufkin Rule Company, are proud to have received the Army-Navy Production Award in recognition of the quality and quantity of precision measuring tools we have produced. Scarcely a single part of the vast supply of war equipment America today is producing can be made without the aid of precision tools, measuring tapes or rules.

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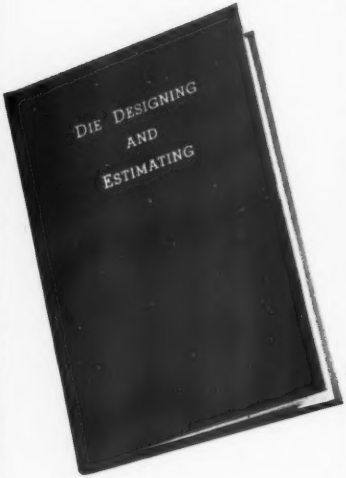

CONTENTS

New Chapters include:
Progressive Dies
Compound Dies
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(Deep drawing section on cartridge case design, mathematical and graphical methods of determining diameters, shell wall thicknesses, punch and die sizes)

Outline of Equipment and Operations for Manufacture of Small Arms Cartridge Cases

15 New Estimating Tables

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150 Practical Points on Die Designing and Building

★ "Will be extremely helpful to us . . . .", "very practical", "even better than I had hoped it would be"—these are comments by men in the precision tooling industry who have examined the new second edition of "Die Designing and Estimating". Orders for 50 copies (most on a second order after the book was reviewed) from a public library, 28 copies from an airplane manufacturer, 24 from an apprentice training instructor testify to the usefulness of this book. Largely written on request by specialists, the book covers its subject concisely, systematically and with authority.

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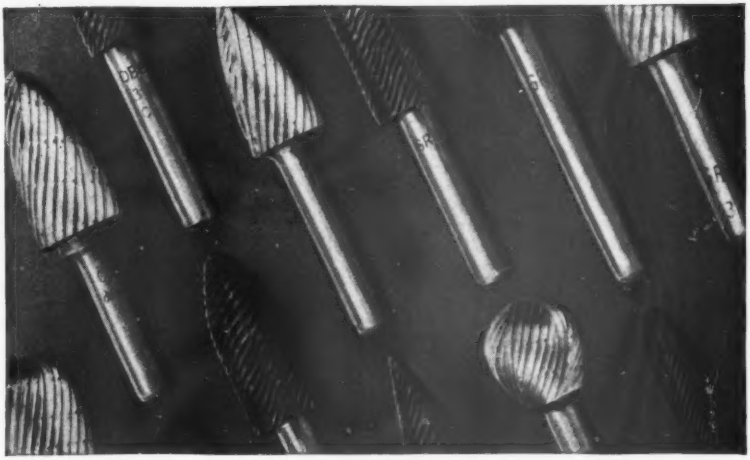

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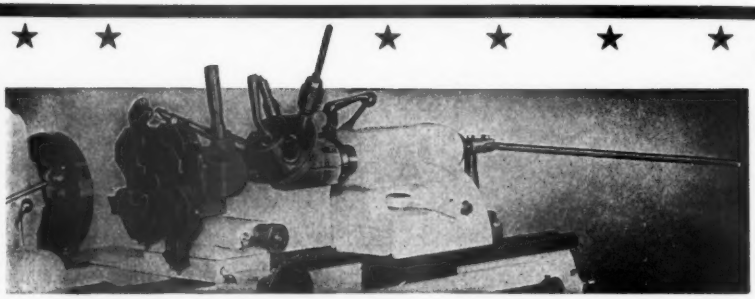
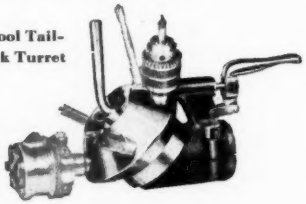


Photo above shows Jefferson Turrets on 16" lathe

Convert YOUR ENGINE LATHE INTO A TURRET LATHE IN 15 SECONDS

5-Tool Tail-Stock Turret



Yes, it's as easy as that! You simply attach the Jefferson Tail-Stock Turret, the Jefferson Tool-Post Turret, and the Jefferson Adjustable Pull Feed to your lathes as shown in illustration, above.

The productive capacity of these machines will be more than doubled in many instances because there will be available at all times NINE DIFFERENT TOOLS.

With these three JEFFERSON time-saving devices attached to a lathe, any kind of work may be done, such as forming, roughing, boring, finishing, knurling, drilling, tapping, etc., without stopping the lathe, or changing tools. THE JEFFERSON TURRETS are made very substantial, rigid, accurate and in several sizes to fit small bench lathes up to 24" swing.

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4-Tool Tool-Post Turret

We also Manufacture the Jefferson Bull Dog Precision Milling Machine. Obtainable Power or Hand Feed.

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Welch
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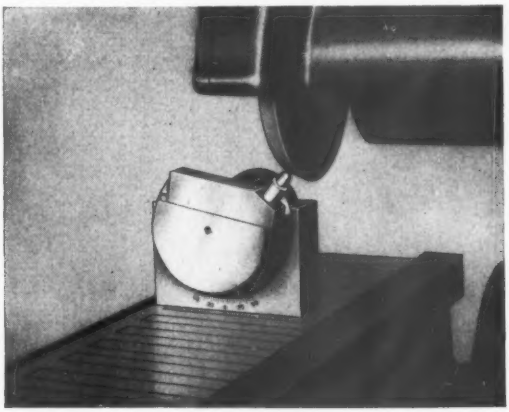

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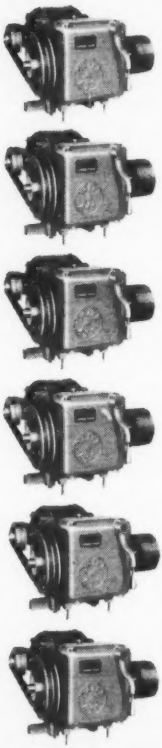

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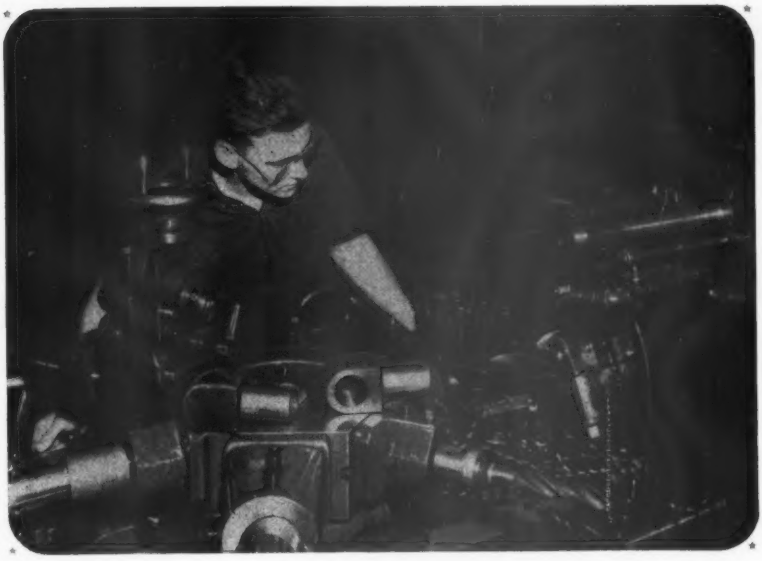

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Standardized Spindle Nose. Spindle heat-treated chrome-nickel steel with No. 40 taper.

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Controls for speed and feed are centrally located for ease of operation.

Table working surface	46" x 10¼"
Longitudinal power feed	25"
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Max. distance spindle to table	19"
Number of geared feeds	16"
Range per spindle revolution	.005" to .212"

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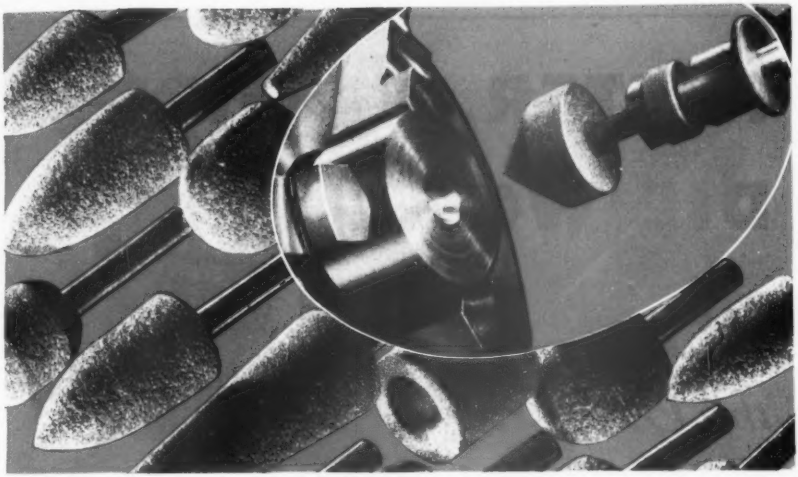

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*Half a century of specialization has established our reputation as the small wheel people of the abrasive industry.

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● Wherever you find a Chicago Mounted Wheel at work, you'll find 100% grinding speed and efficiency.

Mounted firmly on its own steel shank, each wheel is a whirling point of easily controlled power that cuts valuable man-hours.

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Available in 300 shapes and sizes — every grade and grain — a best wheel for every job.

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Tell us kind of job, type grinder you use and size wheel you'd like and we'll send one postpaid for you to try.

NEW CATALOG — Shows Chicago Mounted Wheels in actual colors, also portable electric tools and time-saving accessories.

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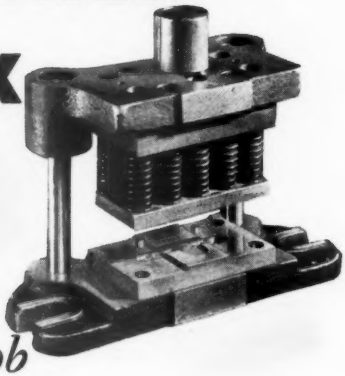
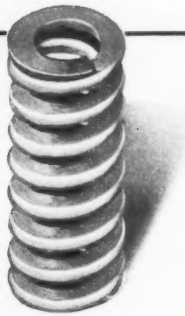


By using the Die Spring Tailored for the Job



WARTIME die work demands greater speed and accuracy. You can meet this demand by using the die spring tailored to the job... and to the press. Customized die springs for each particular requirement are available at Muehlhausen; in series "S" for high speed, "M" for regular speed, and "HD" for heavy duty presses. Over 200 sizes are stocked, ranging from 1 to 15 inches in length, from ¾ to 4 inches in diameter, and from 80 to 3000 lbs. in load capacity.

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We went to 3-shift operation in June of 1940. We did it for defense. We saw you coming, Hirohito, before Pearl Harbor. Danly Die Sets today are holding the dies that pound out plane parts, rifle parts, machine gun parts, tank parts, ship parts, submarine parts, parts for the defense of America and the defeat of the Axis.

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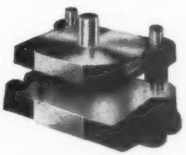
You dared to challenge the American workman in his chosen field—Mass Production—and to threaten the security of his homeland.



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Welded Steel Fabrication

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ABRASIVE
No. 1½ HAND FEED SURFACE GRINDER

WORKING FOR VICTORY, women in ever increasing numbers are taking the place of men in wartime industry. Many have become proficient operators of the Abrasive No. 1½ . . . and have done so in a remarkably short time. On the production line or in the tool room, its easy operation, convenient controls and dependable precision permit them to turn out maximum production with a minimum of fatigue.

The Abrasive No. 1½ gives a fine finish and is particularly suited for the most accurate type of flat, form, and gage grinding. It is designed to handle work of many shapes and sizes . . . particularly short-run jobs which do not warrant the bother of adjusting automatic feeds and stops. It has an unusual capacity, accommodating work 15" long x 10" wide x 12" high.

Built-in motor, integral with head

Hand feeds, few moving parts: No belts, no chains, no sprockets

Large handwheels, conveniently located

Vertical adjustment, rapid and sensitive

Bearing surfaces easily lubricated

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The No. 1½ Grinder illustrated and the Abrasive power feed grinders—Nos. 3B and M-3 with horizontal spindles and No. 34 with vertical spindle — are described in Sweet's Catalog, or in more detail in separate bulletins available from dealers or the factory.

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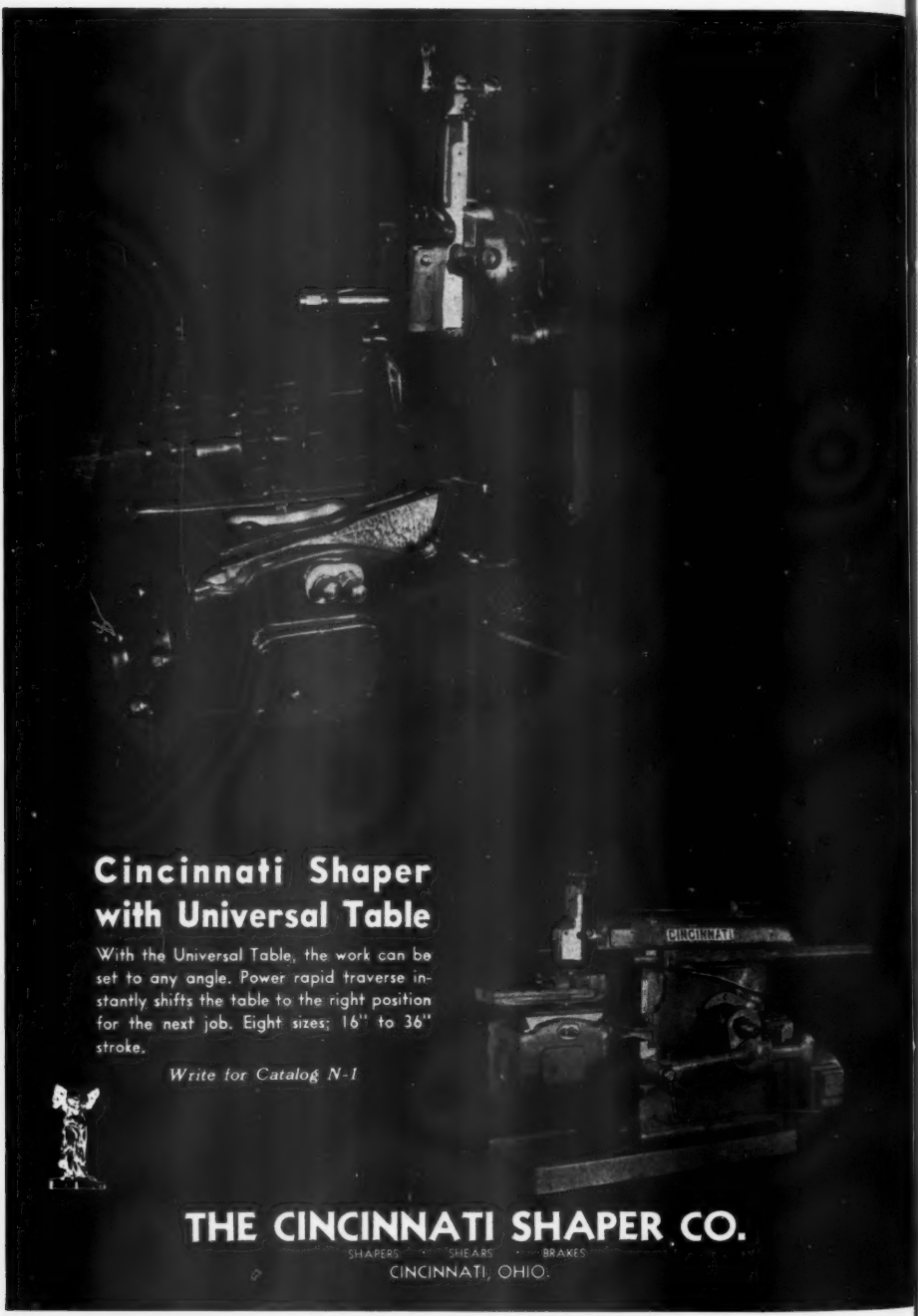

Cincinnati Shaper with Universal Table

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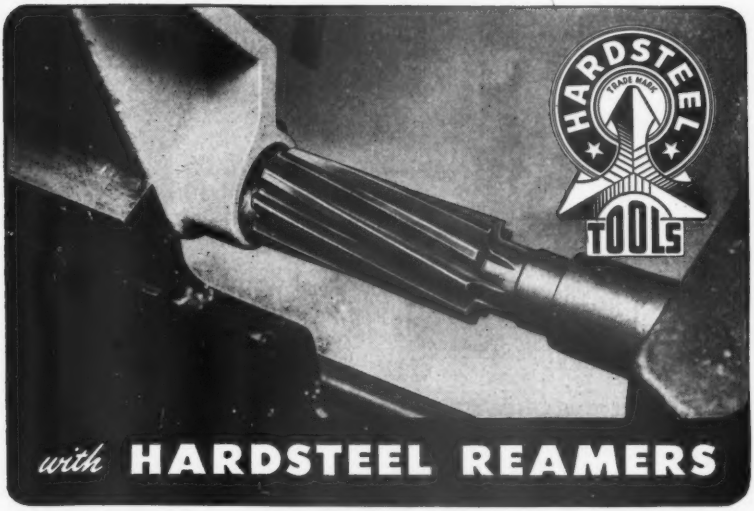
YOU CAN REAM
HARD · TOUGH · ABRASIVE
ALLOYS AND PLASTICS



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Bomb rack hinges are made of an aluminum alloy—heat-treated for hardness yet tough to machine and tougher on tools because of the abrasive action of the metal.

A Cleveland manufacturer solved the almost impossible job of putting a blind hole 1 5/16 in. diameter and about 5 in. deep in these castings, using "HARDSTEEL" Reamers and taking off .015 in. of metal on a side while holding tolerance to .002 in.

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DRILLS · REAMERS · TOOL BITS · SPECIAL TOOLS

HERE is illustrated an Ex-Cell-O Tool Grinder especially designed to produce the fine cutting edge that today's cutting tools must have for the greatest production efficiency. This is Style 44, one of six styles of Ex-Cell-O grinders for the speedy, economical conditioning of cutting tools . . . whether made of carbide, stellite, high speed steel.

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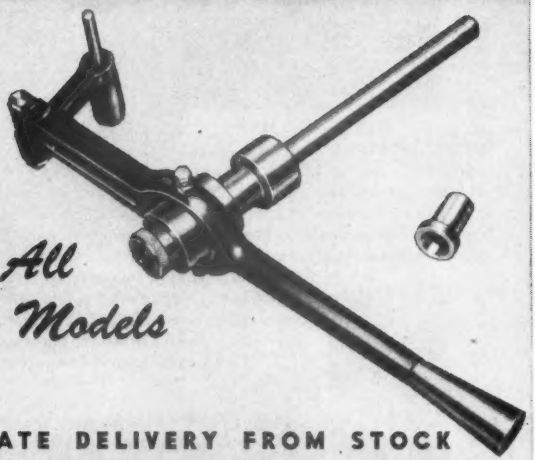
Announcing!

Patent Pending — Infringements will be prosecuted

THE NEW Precision LEVER-TYPE Drawbar



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Simpler and more foolproof than other models now in use, *Precision's* Co-ordinate Cam Principle reduces friction to a minimum, eliminating the need for bearings — results in easier operation. It is ruggedly built for continuous production use and will last indefinitely . . . Make sure to specify *Precision* when ordering from your dealer. He can supply you with this new and radically different Lever-Type Drawbar.

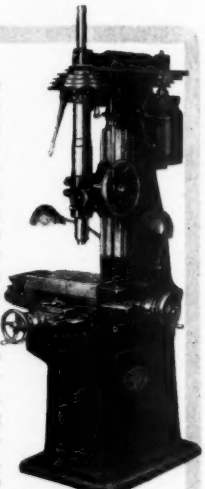
GENERAL DIE-STAMPING-TOOL COMPANY

PRECISION COLLET DIVISION · 265 Canal Street, New York City

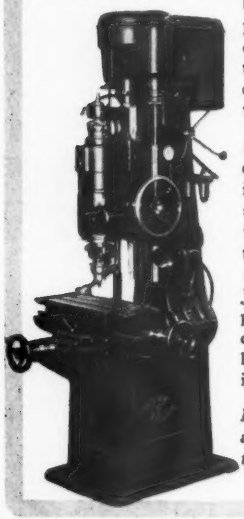
Teamwork SCORES IN THE TOOLROOM, TOO

Official Photo
U. S. Army
Signal Corps

The mechanical time fuse which fits in the nose of anti-aircraft shells is a complicated piece of clockwork requiring multiple-station dies of extreme precision. These dies were designed and produced by Moore tool-and-die specialists, aided by the speed and efficiency of the Moore Jig Borer and the Moore Jig Grinder, "Partners in Production."



MOORE JIG BORER bores the holes in the die sections before hardening, thus holding the location as close as possible to eliminate excessive grinding. Easy to operate, it features a fundamental process of coordinate location which permits accurate spotting, drilling, reaming and boring in one uninterrupted sequence. The speed with which accurate settings can be made simplifies layout and jig-boring problems. It produces more holes to closer tolerances (±.0001") in less time than any other type of jig-borer...holes of 1/32" or smaller and heavy cuts up to 4½".



MOORE JIG GRINDER finishes the pieces of the multiple-station dies after hardening. Instead of grinding the holes in each section of the die at a time and going through all of the laborious steps of centralizing, locating, indicating, grinding, re-assembling and checking, the Moore Jig Grinder does it all in one setting, with the die completely assembled in its own die-set and located on its own dowels—*in one-quarter the time!* It has a capacity to grind holes from .030" to 4", accuracy of screws of .00005" per inch, and grinding speeds of 15,000 and 45,000 RPM.

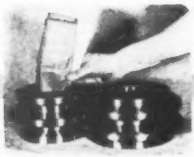
Discover how these two machines and their time-saving accessories can modernize your toolroom operations. Write today for descriptive catalogs.

Manufactured by MOORE SPECIAL TOOL CO., INC • ***Bridgeport, Conn.***

MOORE TOOLS

EXCLUSIVE DISTRIBUTORS: MARBURG BROTHERS, INC • 90 WEST ST., NEW YORK, N. Y.

Just what the Roll-Grinder ordered!



FOR the first time it has ever been done . . . the best ideas gained by years of experience in a production roll-forming shop, have been engineered and built into a grinding machine. Specially designed for the grinding of rolls, it does this job quicker and easier. Its set-up facility lowers costs and the handling ease reduces the fatigue factor. Both are of paramount importance in the efficient operation of the grinding of rolls.

"The Yoder ROLL-GRINDING MACHINE HELPS TO *Keep 'Em Rolling!"*

Yoder

ROLL-GRINDING MACHINE

- Capacity 16" diameter, length 20" between centers.
- Manually synchronized table and cross feeds.
- 2 speed table feed.
- 9 speed work head drive, without belt or gear change.
- Precision built high-speed spindle.
- Dust protection.
- Centralized controls.

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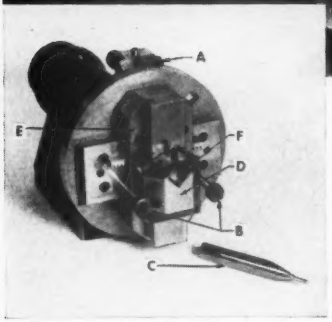
METAL • FORMING • PRODUCTION • MACHINERY

ENGINEERING YODER MANUFACTURING



This photograph illustrates clearly the working parts of the Perfex Dresser.

A Vernier

B Stop Pins

C Dressing Diamond

D Radius Adjustment

E Tangent Slide

F Dressing Tool Mounting

Delivery Reasonable delivery on all Perfex Dressers with necessary priorities.

Saves on SET-UP Time

The exclusive feature of Perfex's diamond mount construction and the way in which the shank of the diamond tool is ground, automatically locates the diamond on perfect center every time. To illustrate see cut at left showing 90° vee in dresser's diamond mount block, and also flats ground on diamond tool shank. There is no guesswork or wasted time in set-ups with a Perfex Dresser. For detailed information write for literature today.

1 The Perfex Dresser dresses in horizontal position exactly in the plane in which the work will be ground. This allows wheel dressings to be thrown away from the dresser into the dust collector.

2 **The radius can be set accurately to within .0001.**

3 All moving parts made from hardest steel ground and lapped to a perfect fit.

4 It is possible to return the diamond to center after dressing an angle within .00005.

5 It is possible to dress a .050 radius to a full half circle ***without additional attachments.***

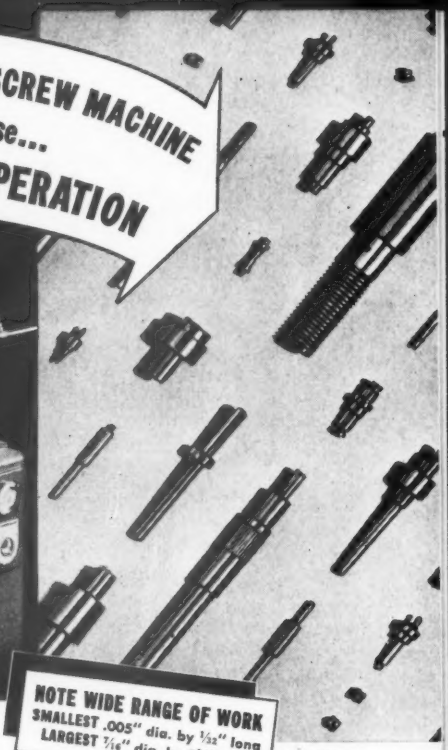
6 Vernier is very legible, can be easily read from normal position.

7 All surfaces protected from rust.

PERFEX DRESSER CORPORATION
3607 GAYLORD . DETROIT, MICHIGAN

NEW *Precision* AUTOMATIC SCREW MACHINE
Solves Tough Jobs Like These...
Complete – IN ONE OPERATION

GORTON
Product of Two Names Famous for Precision
The Original Swiss PETERMANN Model P-7
Re-engineered by GORTON Improved - Modernized



NOTE WIDE RANGE OF WORK
SMALLEST .005" dia. by 1/32" long
LARGEST 7/16" dia. by 2 3/4" long

PARTS SHOWN ACTUAL SIZE

GORTON ANNOUNCES a new, more versatile Precision Automatic—the Model 16-A Screw Machine. Built to meet America's emergency and post-war critical needs for mass production of extremely small, intricate parts. Long, slender pieces—multiple diameters are finely finished to closer tolerances, in one operation. Unique design offers almost limitless scope in generating any shapes. Present deliveries, 6 to 8 weeks.

Exceptional **ACCURACY AND QUALITY OF FINISH** High diametrical accuracy—work rigidly supported at point of cutting tool load. Unusually high finish—grinding often eliminated.

LOW TOOL AND OPERATING COST... Maximum accessibility for quick set-ups. Uses only standard single point tool bits. Micrometer adjustments on every tool. Centralized controls — infinitely variable speeds and cam feeds at touch of dials.

LONG LIFE OF PRECISION PERFORMANCE... Slow movements—short stroke —freedom from vibration.

OUR GOLDEN ANNIVERSARY
1893-1943

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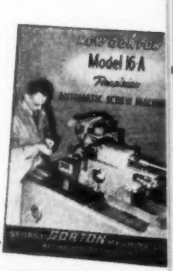
Write Today For FREE Bulletin



MAIL TODAY

GEORGE GORTON MACHINE CO.
1319 Racine St. Racine, Wis.

Send me, without obligation, FREE bulletin with complete information covering the Gorton 16-A Precision Automatic.

Name .....

Title .....

Company .....

Address .....

City .....

State .....

GEORGE GORTON MACHINE CO.

1319 RACINE STREET, RACINE, WISCONSIN, U. S. A.

SPECIALISTS FOR 50 YEARS IN REPRODUCING FROM MASTERS—ENGRAVING, DIE MAKING, VERTICAL MILLING MACHINES

SPEED UP ALL PRODUCTION DRILLING
with these 3
SKILDRILLS!
MODEL "45"
¼ IN. SKILDRILL
MODEL "47"
¼ IN. HEAVY DUTY SKILDRILL
The many other SKILSAW DRILLS give you a size and type for every drilling job!

● Everywhere SKILDRILLS are boosting War Production by boosting drilling output on every job! In aircraft plants SKILDRILLS speed up "skin-drilling" . . . on tank and engine assembly lines they "shoot holes" in drilling bottlenecks . . . throughout industry they're busy drilling *more holes in less time.* SKILDRILLS are light, compact, powerful . . . they get in tight places *easier* . . . go through tough metals *faster* . . . give you more drilling power and speed for every ounce of weight!

The features that make SKILDRILLS so superior are typical of the full line of SKILSAW DRILLS . . . a size and type for every job from fastest production drilling to heaviest boring and reaming. Ask your distributor to demonstrate SKILSAW DRILLS on your own work . . . today!

SKILSAW, INC.
5061 Elston Ave., Chicago, Illinois

New York • Boston • Buffalo • Philadelphia
Cleveland • Detroit • Indianapolis • St. Louis
Kansas City • Atlanta • New Orleans • Dallas
Los Angeles • Oakland • Portland • Seattle
Toronto, Canada

KEEP 'EM RUNNING FOR FREEDOM

Available from stock in three sizes.

	Normal Height	Width	Normal Length
No. 1 (small)	2"	2 9/16"	4 1/2"
No. 2 (medium)	2 3/8"	3"	6 1/8"
No. 3 (large)	3 1/8"	4"	8 1/8"

Set your *NEW* machines on *Empco* LEVELING JACKS

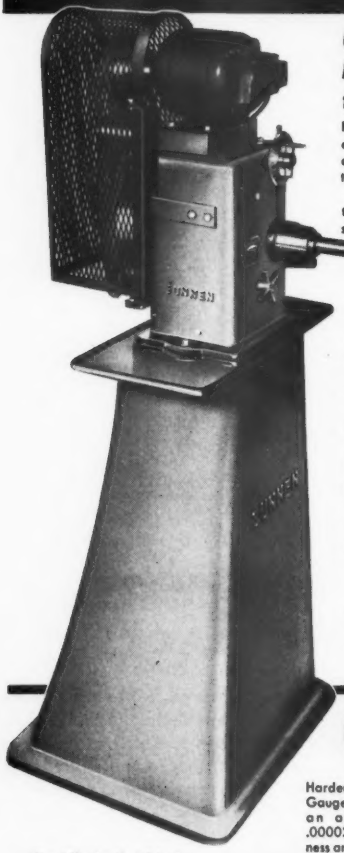
Machine Tool Manufacturers strongly emphasize the need, not only to set machines *level*, but to *keep* 'em that way. Periodic re-leveling is essential for accurate work tolerances. How often, depends on the type of foundation. No method of machine setting is stable enough to maintain the accuracy of initial leveling. It is important to check after first month of operation, then check periodically and re-level whenever necessary.

When a machine is set on EMPCO JACKS, the whole operation is the work of but a moment: Simply apply a wrench to the "hex" screw head, turn right or left until your level indicator reads "zero".

EMPCO

THE ENTERPRISE MACHINE PARTS CORPORATION
2735 JEROME AVE. DETROIT, MICH.

DON'T THROW AWAY YOUR BROACHES or REAMERS Because they are a LITTLE UNDERSIZE



Use the SUNNEN "MA" Precision HONING MACHINE to take out that Last Thousandth or so . . .

Reamers and broaches are expensive — and hard to get! Don't discard them simply because they are a little undersize. Go ahead — use them as long as you can — and remove that last thousandth or two with the Sunnen "MA" Precision Honing Machine.

Leading defense manufacturers the country over are using this inexpensive machine to accurately finish internal cylindrical surfaces from .185" to 2.400" Accuracy within .0001" is guaranteed and has often been held to .000025" in production work.

Solves Five Important Problems

1. Corrects errors of out-of-roundness and taper caused by previous operations.
2. Produces super-smooth surface finishes.
3. Accurately finishes holes to very close tolerances both as to size and straightness.
4. Maintains alignment already established by previous operations.
5. Provides simple, low cost method for accurately duplicating sizes.

Relieves Big Internal Grinders—Can Be Set Up in a Minute—Does Not Require Skilled Labor

Fast — not only in production, but can be set up and work located in a minute. Any intelligent workman—or girl—can produce precision work with only a few hours' practice. You can shift your highly skilled labor to other jobs.

Write for **FREE** *Bulletin*

giving complete information and showing many examples of use. Or if you prefer, we'll have a sales engineer call and demonstrate this equipment in your plant, on your job.

SUNNEN

Hardened Steel Ring Gauge — finished to an accuracy of .000025" for roundness and straightness.

Drawing and Blanking Die "Saves time in producing smooth base metal finish."

Inner Bearing Ring "Accurately removes last 'tenth' of stock."

Diesel Engine Fuel Injector Cylinder "So accurate that a piston can be fit within .00005 inch."

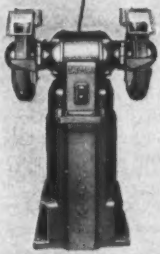
Bronze Valve. The Sunnen method of honing is used to secure a high finish and accuracy.

SUNNEN PRODUCTS CO. 7947 Manchester Ave. St. Louis, Mo.
Canadian Factory: Chatham, Ontario

ELECTRIC LIMA MOTORS

LIMA PRODUCTS . . . ENGINEERED for PERFORMANCE, DEPENDABILITY, and LONG LIFE . . .

MOTORS ½ to 75 H. P.



PEDESTAL GRINDERS
2 AND 3 H. P.

MAGNETIC POLISHING LATHES
BUILT-IN RECTIFIER FOR D C CURRENT

GEARSHIFT DRIVES
1 to 25 H. P.

Lima Products, engineered for precision applications, will continuously deliver full rated power performance under the most adverse operating conditions.

To serve American Industry, our field engineers have been specially trained in all phases of motive power application for machine tool and production equipment. Lima Products, plus Lima Engineering Service are the dependable answers to your motor or machine tool production problems.

Many exceptional features such as oversize shafts and bearings, dynamic balancing, heavy rugged frames, etc., are responsible for Lima's outstanding ability for long profitable life. Wire or write today for address of Lima Engineering Service nearest you.

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Send for new descriptive catalog showing the LIMA line.

ELECTRIC LIMA MOTORS

Large enough to successfully serve you, yet small enough to give personal attention to your needs.

DRIP-PROOF 1 to 75 HP

THE LIMA ELECTRIC MOTOR CO.
857 FINDLAY ROAD
LIMA, O. U. S. A.

EXPLOSION-PROOF 1 to 5 HP

POLISHING LATHES | OPEN | VERTICAL | TOTALLY-ENCLOSED

Need Gauges in a Hurry?

Here is how to order them for Fast Delivery

To insure fast delivery of Turner gauges we urgently suggest the use of the following information. This information will eliminate any oversight in listing specifications and save valuable time in unnecessary correspondence.

1 & 2 STANDARD PLUG AND RING GAUGES

(1) Diameter. (2) Length of gauging surfaces. (3) Tolerance or accuracy. (4) Hardened alloy steel or chrome. (5) No. of Members Go, Not Go, Handles (for plugs only). (6) Complete marking instructions. (7) Date that percentage of total order must be received.

3 SNAP GAUGES

Send complete specifications and blueprints and definite date order must be received.

4 FLUSH PIN

Send complete specifications and blueprints and definite date order must be received.

5 BUILD UP

Send complete specifications and blueprints and definite date order must be received.

ENGINEERS: In designing plug and ring gauges bear in mind that standard lengths will speed up the delivery of your gauges.

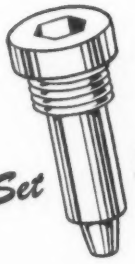
TURNER BROTHERS

TURNER GAUGE GRINDING COMPANY

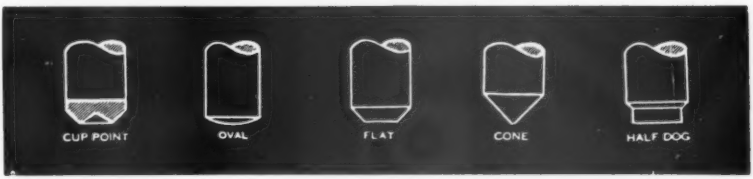
2624 HILTON ROAD • • • • FERNDALE, MICH.

TOUGH But Not BRITTLE!

Safety SUPER-DUTY Set Screw



An unusually strong set screw with all threads die cut — class 3 fit. The sockets are accurately broached, clean and free from grit. The screw is made from special alloy steel, which has been heat treated for maximum toughness, with a tensile strength of 225,000 lbs. to the square inch. The Safety Super-Duty is furnished in any style point shown below.



NATIONAL GRINDING WHEELS

Pay for themselves with longer life, higher grinding speeds and fewer breakdowns! They are investments which pay big returns on production work!

TRY ONE FREE **. . . If you'll give us complete information on the grinding job you have to do, we'll send you a wheel without obligation.**

MANUFACTURERS SUPPLY COMPANY
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YOUNGSTOWN: C. H. WILTSIE, 4177 OAK KNOLL DR.
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PITTSBURGH: L. A. REISMAN, 2035 FIFTH AVE.

IT'S NO WAR SECRET — *U. S. Plants All Over the Country Are Doing This!*

SOME USERS OF TURNER UNI-DRIVE

Aberdeen Proving Ground
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Automatic Sprinkler Co. of Amer.
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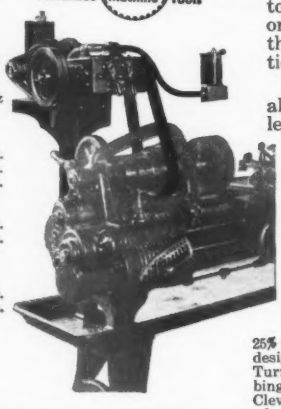
Burgess Batt. Corp.
Cessna Aircf. Corp.
Champion Dishwashing Co.
Chicago, Rock Island & Pac. Ry. Co.
Chicago Screw Co.
Cincinnati Time Recorder Co.

TURNER UNI-DRIVE
Motorizes Machine Tools



NO SIR! Hitler and Hirohito, this is no military secret . . . you are welcome to this information. Every time a shop or factory installs UNI-DRIVE units, they bring your defeat and destruction one more day nearer.

Each unit operates independently of all others. It eliminates overhead pulley adjustments, countershafts, ceiling vibrations, spindle speeds, belts to shift. Provides high and low speeds on all equipment at a touch of the gear box, started or stopped independently of other equipment in operation.

Increase Production Capacity 25% to 300%

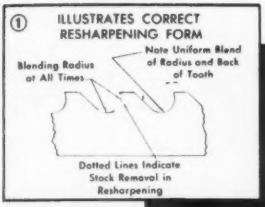
IN HUNDREDS of plants all over the country, these motorizing units are speeding up production capacity 25% to 300%. Quickly and easily installed. Specially designed for Lathes, Milling Machines, Shapers, Turret Lathes, Radial Drills, Boring Mills, Hobbing Machines . . . also Browne & Sharpe and Cleveland Automatic Screw Machines, and easily adapted to many special applications.

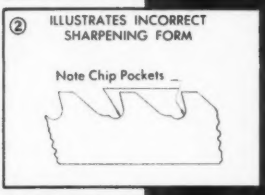
See your dealer today or write

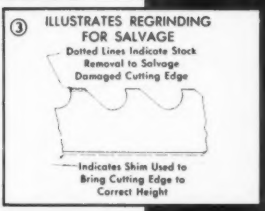
The TURNER UNI-DRIVE COMPANY
(Sales Div. Turner Machine Co.)
3416 Terrace Street **Kansas City, Missouri**

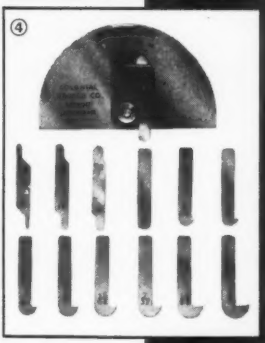
NOW AT WORK FOR VICTORY ★★★

PRODUCING MACHINE TOOL DRIVES • ORDNANCE TOOLS • AIRCRAFT FITTINGS


① ILLUSTRATES CORRECT RESHARPENING FORM
Note Uniform Blend of Radius and Back of Tooth
Blending Radius at All Times
Dotted Lines Indicate Stock Removal in Resharpening




③ ILLUSTRATES REGRINDING FOR SALVAGE
Dotted Lines Indicate Stock Removal to Salvage Damaged Cutting Edge
Indicates Shim Used to Bring Cutting Edge to Correct Height



How to get more production with your Broaches------

2. BY PROPER SHARPENING

(a) Any marked departure from the original size and form of teeth in resharpening broaches will result in incorrect cutting action. Have the manufacturer supply you with a blueprint for use as a guide.

(b) Always blend the radius of the broach when sharpening teeth. Fig. 1 shows how to successively resharpen a broach.

(c) Don't sharpen a broach in the manner illustrated in Fig. 2. The pockets at the base will prevent chips from clearing the teeth, slow up production and possibly break broach teeth.

(d) Where surface broaches can be adjusted for height, it is permissible to sharpen broaches as shown in Fig. 3. When this is done, care must be taken to maintain proper stepping, backing off and tooth depth.

(e) It is always advisable to check the radius at the bottom of the tooth with simple radius gages as shown in Fig. 4, to keep broaches at peak of efficiency and prevent broach damage from incorrect sharpening.*

(f) Play safe: Don't use makeshift equipment to sharpen broaches.**

*Available in sets at a nominal price from Colonial.

**Colonial Universal Broach Sharpening Machines are equally adaptable to sharpening of both flat and round broaches.

colonial BROACH COMPANY

Broaching Machines — *Broaches-Broaching Equipment*

DETROIT . . . . . U. S. A.

Sell a Customer a Tool Welding Rod Without Proper Engineering and Supervision and You Spoil the Job

There is only one SUTTONIZING welding process for the reclamation of hi-speed steel cutting tools. Imitators who attempt to follow in the footsteps of the long tried and true SUTTONIZING practice, find the going extremely *tough*.

Let us elaborate: First of all, any material sold for hi-speed tool repair in your shop is usually doomed to failure, principally because the user cannot pass through the rigorous experimental stages that the Welding Equipment & Supply Company have. The Welding Equipment & Supply Company are *positively* the indisputable *originators* of this process. Then too, the lamentable fact remains that the seller of any rods purporting to work as well as SUTTONIZING must fail because that vendor would not have the engineering talent at hand to properly institute this work in any welding department.

As a matter of fact, we have tried and miserably failed in most instances to achieve satisfactory results except *in our own plant* under the keen and painstaking scrutiny of our engineers, using only skilled operators, well seasoned in this delicate welding process.

For complete details on SUTTONIZING write or wire us today.

WELDING EQUIPMENT & SUPPLY CO.
226 LEIB ST. **DETROIT, MICH.**

Faster, more accurate tapping with

New "TRU-GRIP" TAP HOLDER

Equipped with MORSE TAPER SHANK

● Production line tests show definitely that speedier, more accurate tapping, with less tap breakage, results when this new Tru-Grip Tap Holder is used. It is equipped with Morse Taper Shank for more efficient tapping on machines with reversible spindles and multi-spindle drill presses. Shank and body are hardened and ground for maximum accuracy. Special design makes this the lightest tap holder on the market — one-third the weight of conventional tap holders.

Offers many exclusive features

A broached section in the chuck receives the flattened surfaces on the spring collet, while the tap has a positive drive through the square hole broached in the collet. The tap is held in true alignment by the round of its shank, and tap shanks are never scored or disfigured. Other features include: Wide range of tap capacity; one-piece body and shank; accepts standard size taps.

SEND FOR BULLETIN

giving full details, prices, specifications of "Tru-Grip" Tap Holders; Collets, as well as Procunier Tapping Heads and Procunier Tapping Machines.

PROCUNIER

SAFETY CHUCK COMPANY

12-14 S. Clinton St. Chicago, Ill.

PROCUNIER SAFETY CHUCK CO.—
12-14 S. Clinton St. Chicago, Ill.

Send me bulletins on: ☐ Tru-Grip Tap Holder ☐ Universal Tapping Machines ☐ High Speed Tapping Heads.

Name.....

Address.....

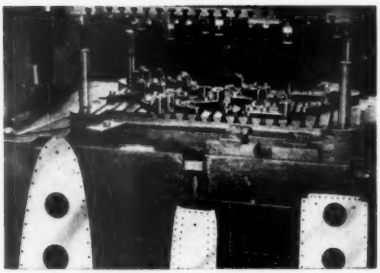
City.....State.....

ADJUSTABLE DIES
SPEED WAR PRODUCTION

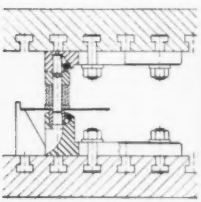
INCREASE HOURLY PRODUCTION—REDUCE "DOWN" TIME

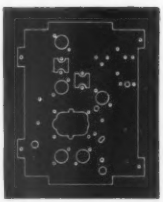
Whistler adjustable die set-up for 12 foot power brake. These same punch and die units can be quickly rearranged for other patterns.

Whistler Adjustable dies are saving the day in war plant "speed-up" schedules by...saving weeks of time normally required in single purpose die making...units can be used over and over in different patterns...new set ups on or off the press in minutes ...all parts interchangeable...work on any type press...perfect precision on long or short runs...no special tools and new workers quickly learn to make press changes.

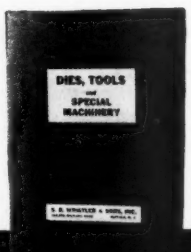


Another grouping of Whistler Adjustable Dies illustrating re-use of same units. Note close grouping of perforations.





Side view showing construction detail of U-50 Whistler Adjustable Punch and Die unit and typical example of perforated and notched piece produced by Whistler Dies.



Over 25 Years of Tool and Die Making Experience

S. B. WHISTLER & SONS, Inc.
752-756 MILITARY ROAD BUFFALO, N. Y.

Every Production Executive needs this fully illustrated catalog. Sent upon request.

Magni-Ray

"A REMARKABLE CHANGE HAS BEEN EFFECTED IN OUR SHOP BY NEW MAGNI-RAY"

says Mr. Christian Dahlerup, Supt. of the Atlantic Gear Works.

"Before the great rush in our business we would have never believed that a simple instrument like the **MAGNI-RAY** could be of such great importance in our work.

"We were used to seeing our men, particularly Toolmakers and Machinists groping around with magnifying glasses or with watchmakers' loupes clamped on their eyes, trying to read verniers, mikes, dials, inspecting work, examining cutting edges of tools, grinding and gear cutter marks, burrs, etc.

"A great waste of time which we thought unavoidable was continually going on. Now we have your **'MAGNI-RAY'** in various convenient positions in the shop and it is a pleasure to see the men making use of them, which has helped to accustom them to do better work, more neatness in precision work and saving in time. The **MAGNI-RAY** will show anything up clearly in even the darkest parts of our shop.

"We would not like to go back to the old way, and we are glad to recommend this instrument to every shop doing precision work."

NEW MAGNI-RAY has been developed to meet the needs of thousands who require a wide-field illuminated magnifier. **MAGNI-RAY** offers scientifically correct lighting directly on the object in the magnification field. Outside reflections are completely shut off and the bulbs are shielded in such a manner that no light rays are thrown back into the eyes of the user.

Model A. Consisting of **MAGNI-RAY** unit with 3 inch optical glass lens, complete with two bulbs, electrical equipment, swiveling clamp and stand. **Price $18.50.**

Model B. Consisting of **MAGNI-RAY** unit with achromatic lens magnification field of 2 inches and magnification power of 3 plus, complete with two bulbs, electrical equipment for plugging into 110 volt circuit, swiveling clamp and stand.

Price, $27.50

MAGNI-RAY gives clear, undistorted magnification combined with strong, evenly concentrated illumination.

MAGNI-RAY increases efficiency because it reduces fatigue common in inspection work.

MAGNI-RAY quickly detects

★Burrs and poor finish on small parts, screws, pins.

★Cracks in steel after hardening.

★Imperfect welding seams.

★Blow holes in castings for machine tool beds, tools, dies, etc.

MAGNI-RAY can be used wherever magnification is called upon to aid the human eye.

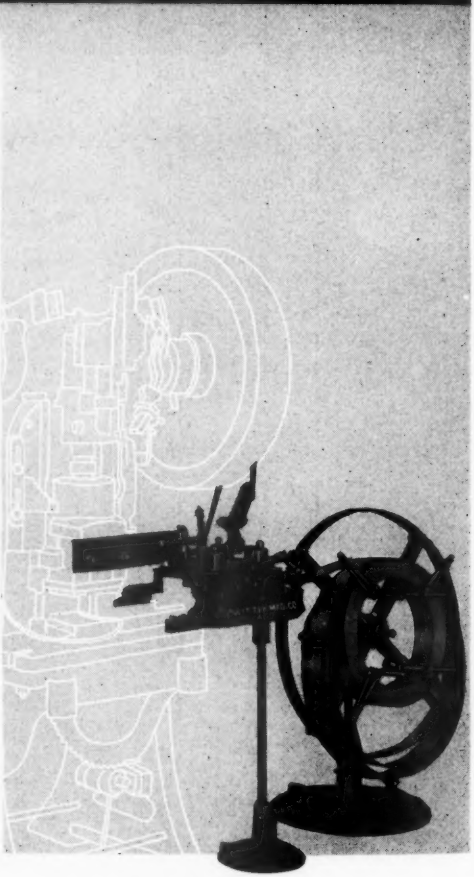
GEORGE SCHERR CO., INC.

128-B LAFAYETTE STREET · NEW YORK, N. Y.

Our Punch Presses Are More Flexible And Productive With WITTEK *Automatic* Roll Feeds And Reel Stands

Manufacturers of metal stampings facing problems in the feeding of coiled strip stock to punch presses will find that Wittek Automatic Roll Feeds and Reel Stands conserve man-hours and achieve new high production levels.

Providing an improved and simplified method of punch press operation, Wittek Automatic Roll Feeds and Reel Stands insure rapid, safe and accurate feeding under all conditions. Made in four different types to meet all automatic feeding requirements. Write for complete details. Wittek Manufacturing Co., 4305-15 West 24th Place, Chicago, Ill.



ARMY E NAVY

WITTEK WMCO *Automatic* ROLL FEEDS and REEL STANDS

For All Makes and Sizes of Punch Presses

there IS a difference in taps

in thread

GRINDING

for example:

All Sossner taps are PRECISION GROUND FROM THE HARDENED SOLID STOCK . . . an important reason for their strength, accuracy, and long life. Sossner taps are made with the very latest equipment, using our own newly developed methods.

TAPS AND GAGES OF AMERICAN NATIONAL AND BRITISH THREAD FORMS IN SPECIAL AND STANDARD SIZES

TAPS
GAGES

SOSSNER

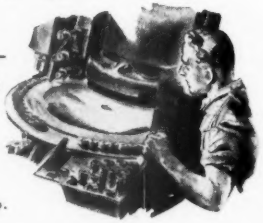
STEEL STAMPS
CUTTING TOOLS

161 Grand St., New York City, or 27 B'way, Lynbrook, N.Y.

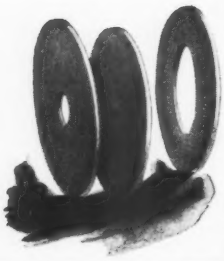
"32 year reputation for reliability and precision workmanship."

This Merry-go-round has gone to war!

1. It takes a lot of parts to make a Jeep. And this "merry-go-round" has the job of grinding some of those parts (those with flat surfaces)...in a hurry! By rotating a large number of pieces beneath a Carborundum made disc wheel, it surface grinds them in a fraction of the time required by older methods. This process is one which Carborundum helped develop.



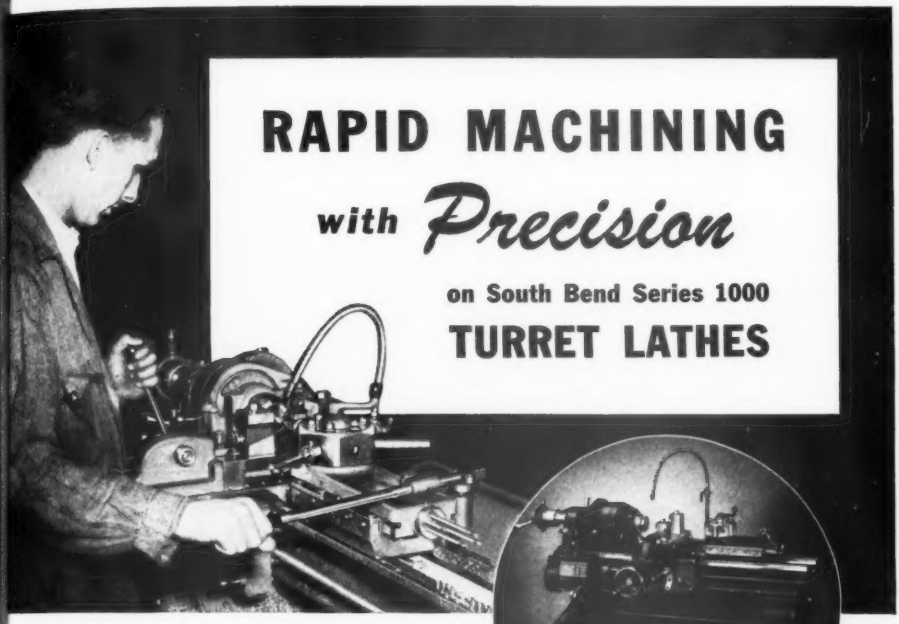
2. Surface ground parts for jeeps, tanks and other weapons just couldn't be finished one at a time; production would be hopelessly low. The introduction of disc wheels and the "merry-go-round" surface grinder put surface grinding on a real mass production basis. The method can be used to generate flat surfaces to precision tolerances, on smallest pieces or on massive forgings and castings. It speeds production of many vital war items from valve springs to connecting rods, from piston rings to clutch plates!



3. Careful supervision of grinding operations is vital today to conserve materials and time. The abrasive disc wheel is a "Weapon of Production" and should be properly used for maximum effectiveness. The Carborundum Company, Niagara Falls, N. Y.

CARBORUNDUM
ABRASIVE PRODUCTS

Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company.



RAPID MACHINING

with *Precision*

on South Bend Series 1000

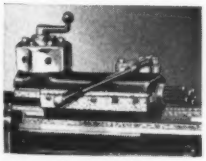
TURRET LATHES

Rapid machining *with precision* is easily accomplished in shops that are equipped with the new South Bend Series 1000 Turret Lathes. Designed for manufacturing small accurate parts, they have the stamina to maintain exact tolerances on volume production without sacrificing speed or versatility.

These Turret Lathes are especially suitable for second operation work. The basic South Bend features that insure efficient production are supplemented by the handlever operation of the turret, cross slide, and collet attachment to speed up machine operation and lessen operator fatigue.

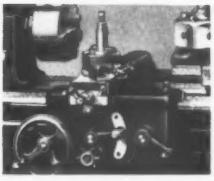
SPECIFICATIONS

Hole through spindle	1⅜"
Collet capacity, round	1"
Swing over bed and saddle wings	10½"
Spindle speeds, (12)	50 to 1357 r.p.m.
Effective feed of turret slide	4"
Thread cutting range, (48)	4 to 224 per in.



HANDLEVER TURRET

Permits rapid positioning of turret tools. Turret indexes automatically on return stroke. Equipped with adjustable stops.



UNIVERSAL CARRIAGE

Provides wide range of feeds—48 power longitudinal feeds—48 power cross feeds—48 threading feeds, 4 to 224 per inch.

SOUTH BEND LATHE WORKS

SOUTH BEND, INDIANA — LATHE BUILDERS FOR 36 YEARS

WOMEN WORKERS CAN HANDLE MASONITE* DIE STOCK

Women workers at Glenn L. Martin Company are shown using dies of Masonite Die Stock in the production of airplane parts by means of rubber hydro-press.

MORE and more women are helping to speed production in America's roaring airplane factories—and many of them are working with Masonite Die Stock.

Because this amazing semi-plastic material is only one-sixth the weight of steel, forming blocks, jigs, templates and assembly fixtures are easily handled by women.

With all its light weight, Masonite Die Stock has great compressive and flexural strength . . . stands up under heavy-duty production runs . . . can be machined and fabricated in metal-working or pattern shops with great speed . . . saves manufacturers precious time, as well as expense in tooling up and getting into production . . . conserves steel for other vital purposes.

Masonite Die Stock is available in thicknesses of ¼ to 4 inches . . . in sizes of 48 x 72 inches and 48 x 144 inches. For further details, fill out and mail coupon below.

*TRADE-MARK REG. U. S. PAT. OFF. "MASONITE" IDENTIFIES ALL PRODUCTS MARKETED BY MASONITE CORPORATION. COPYRIGHT 1943, MASONITE CORP.

ARMY E NAVY

MASONITE CORPORATION
Dept. TJ-5, 111 West Washington Street, Chicago, Ill.

Please send me illustrative literature and complete information about Masonite Die Stock.

Name and firm _____

Address _____

City _____ *State* _____

Why thousands of

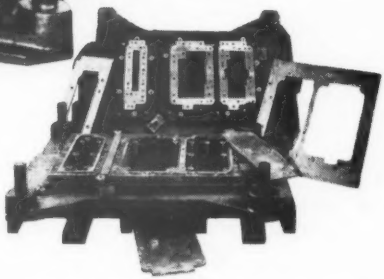
WALES STRIPPITS

(SPRING STRIPPER UNITS)

are used by Tool Engineers

Left—Showing Wales Strippits in die. Note simplicity and compactness of die made possible by using Strippits.

Below—Showing punch and die equipped with Wales Strippits. Orderly arrangement is permitted by uniform pressure of same length Strippits.



Hours of die making time are saved with Wales Strippits by eliminating stripper bolts, grinding springs, boring spring pockets, and drilling and counterboring for stripper bolts.

Only Wales Strippits provide the following advantages:

1. Removing and replacing any stripper plate without disturbing the set-up.
2. Replacing broken or dulled punches is also quickly and easily accomplished without disturbing the die set.
3. Assuring even pressure over entire stripper plate.
4. Using thinner, less expensive stripper plates.
5. Eliminating stripper plate for stripping scrap from die.
6. Designing more compact punch holders and die shoes for more economical and simplified patterns.

Wales Strippits are self-contained, self-aligning units with built-in spring held compressed by retainer and assembly link which exert pressure on stripping plate only when die is punching.

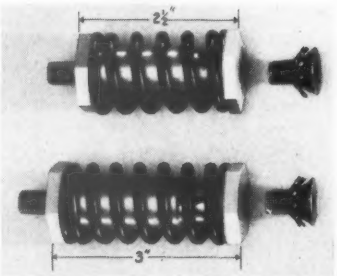
Be prepared by having a stock of Wales Strippits on hand. They can be used on old dies, too! Wales Strippits are surprisingly inexpensive!

Remember, "There's Always Something New in the Wales Line"—so keep posted by writing NOW to—

Wales Strippits are available in 2½" to 6" lengths.

IMMEDIATE DELIVERY

on popular 2½" and 3" lengths.



Above—Showing 2 Wales Strippits with screw threads that hold Strippit to punch or die shoe and other end with tapped hole and screw to hold stripper plate to Strippit.

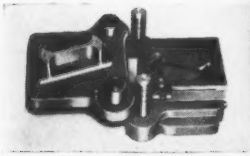
WALES-STRIPPIT CORPORATION

(formerly The Strippit Corporation)
NORTH TONAWANDA, N. Y.
George F. Wales, President
Specialists in Punching and Notching Equipment

"One of the most Outstanding Machines I've ever seen"

JOHN W. RIX, *Mfg. Engineer*, Cessna Aircraft Co.

The Milwaukee Rotary Head Milling Machine "Under Fire" At Cessna



On tools like these no layout was required. All machining was done by working to "dial" graduations. Direct measurements were eliminated.

Proof That This Machine "Has what it takes"

Is Found in Mr. Rix's Statement:

"I consider the Milwaukee Rotary Head Milling Machine to be one of the most outstanding machines I've ever seen for tool room work. It paid for itself in the first few months of operation. We have repeatedly accomplished feats which I would not have believed possible if I had not seen them myself." *(signed)* JOHN W. RIX

Since purchasing their first Milwaukee Rotary Head Milling Machine, Cessna Aircraft has milled hundreds of complicated blanking dies of geometrical form. Furthermore, they milled the punches to fit these dies with .001" clearance in between without resorting to hand fitting of any kind.

This meant that the punches and dies were heat-treated at the same time. Then, after surface grinding, they were ready for mounting on the die set.

• • •

As a leader in your field you should have the complete story on the Milwaukee Rotary Head Milling Machine and its remarkable, low-cost performance. Write for Bulletin 1002A.

Rotary Head Milling Machine
Autometric Jig Borers
Center Scope

Kearney & Trecker
Products
CORPORATION
Milwaukee, Wisconsin
Subsidiary of Kearney & Trecker Corporation

Milwaukee Face Mill Grinder
Milwaukee Midgetmill
Milwaukee Speedmill

T-J DIE SINKING MILLING CUTTERS meet today's production requirements for speed and accuracy with *more work between grinds!*

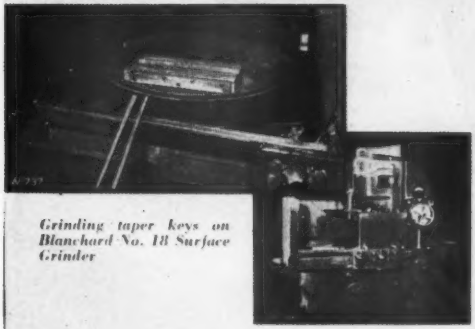
Long years of T-J leadership in this field make T-J Cutters "tops" in design, sturdiness, ability to hold a sharp edge and carry less breakage percentage. T-J Cutters are made from a standard, extremely high grade steel... assuring extra strength, wear resistance and uniformity. Send for new catalog.
The Tomkins-Johnson Co., Jackson, Michigan.

FOR TOUGH JOBS...SPECIFY T-J

TOMKINS-JOHNSON

DIE SINKING MILLING CUTTERS

"PUT IT ON THE BLANCHARD"



Grinding taper keys on Blanchard No. 18 Surface Grinder

EVEN though fixtures are sometimes necessary on a Blanchard Surface Grinder, a simple design is often very satisfactory. A simple tapered shoe is used for holding 16 tapered keys in the set-up shown above. ¼" to ½" of stock is removed from one side of each key to limits of .002". 48 pieces are ground per hour.

If greater production is required, two fixtures could easily be accommodated on the 36" magnetic chuck. Magnetism holds the fixture on the chuck and helps to hold the work down in the fixtures.

The BLANCHARD
MACHINE COMPANY
64 STATE STREET, CAMBRIDGE, MASS.

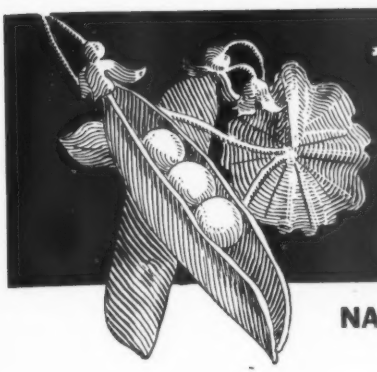
Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.

BLANCHARD

CHECK THESE ADVANTAGES OF BLANCHARD GRINDING

★ Production
★ Adaptability
Fixture Saving
Operation Saving
Material Saving
Fine Finish
Flatness
Close Limits

. . . . . *Especially valuable on jobs like the one illustrated.*



They Look Alike – BUT ARE THEY?

NATURE IS PRETTY GOOD, BUT YOU MUST BE BETTER

"As alike as peas in a pod" is an old saying, good enough in its day. But mass production requires duplication with much greater exactness than anything found in Nature.

Control over mass production demands constant checking. It must be swift, efficient, accurate. The American Amplifying Gage gives you this control. Flexible, easily adapted to your job, it gages pistons, piston pins, bushings, reamers, drills and numerous other precision parts with utmost accuracy. Dial indicator graduated .0001" with a range of .030". Use it for checking thicknesses and diameters up to 5". Send for Bulletin 43-TDJ.

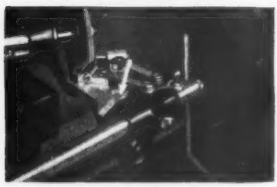
THE AMERICAN GAUGE CO.
125 Bayard Street DAYTON, OHIO

Thread Grinding Simplified

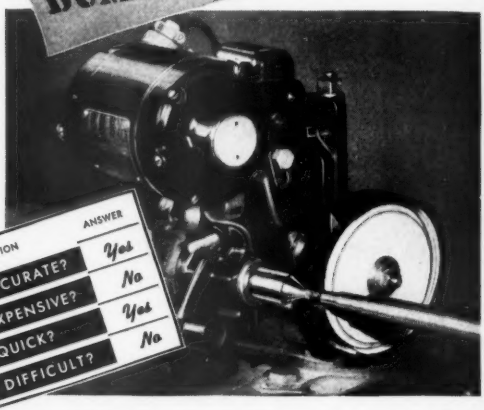
WITH DUMORE GRINDERS

Grinder mounts on special post with lugs for quill and graduations for helix angle.

Here is the set-up, as seen from back of lathe. Motor is up and back from work.



Arrow shows graduated arc for setting wheel dresser to same helical angle as grinder.



Any lathe that can cut threads becomes a thread-grinding machine by replacing the chasing tool with a Dumore No. 5 Grinder equipped with thread-grinding attachment. You can cut threads from solid stock, finish threads already roughed out with cutting tools, or correct threads distorted by hardening . . . all within the regular Dumore tolerance of .0001". ★ External threads are limited only by the pitch and diameter the lathe will handle. Internal threads, in wide range of depths, pitches and diameters can be ground using Dumore internal quills. This time-saving, machine-saving system is a simple set-up with mathematically accurate adjustment of helix angle, plus an equally accurate device for diamond-dressing the wheel. Dressers are available for 60-degree threads, Acme, and other special thread forms. ★ Enjoy the versatility of the Dumore No. 5 Grinder . . . when you've finished your threading jobs use it for fast and accurate cylindrical, taper, and flat grinding on lathes, boring mills, planers and other machine tools. Dumore Precision Grinders and attachments are available through mill supply distributors.

THE DUMORE COMPANY
DEPT. 373E RACINE, WISCONSIN

Dumore

PRECISION GRINDERS

7 SIZES . . . 54 QUILL COMBINATIONS

. . . a name to be remembered.

"THOMPSON" — just a name, but a name to be remembered. To our fighting forces it means "Tommy" Gun — they got them on time, when needed. And our production lines will remember "THOMPSON" — to them it means dependable tools — dependable to work with — dependable because of our ability to produce on time, hundreds, thousands—dependable because the name "THOMPSON" is behind them. On the firing line—on the production line—"THOMPSON" is dependable.

ARMY E NAVY

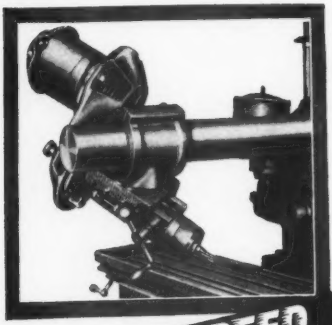
Awarded to Auto-Ordnance Corporation for excellence in production of "Tommy" Guns.

AUTO-ORDNANCE
CORPORATION
Thompson Tool Division

342 WEST PUTNAM AVENUE, GREENWICH, CONNECTICUT

New HALCO UNIVERSAL HEAD

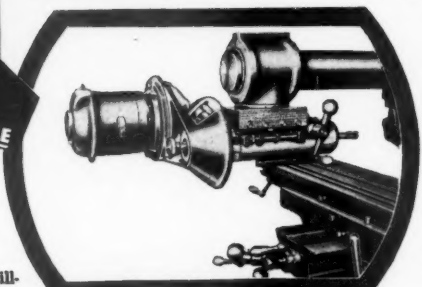
Only Machine Made On This Lathe Principle

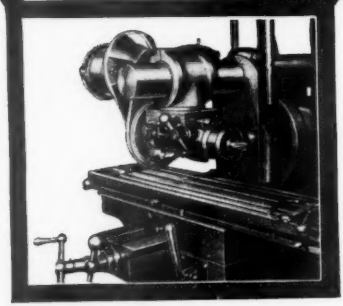


for High Speed MILLING, DRILLING, BORING and COUNTER BORING

Five Speeds 350 to 2900 R.P.M. Also 10 speeds 125 to 2900 R.P.M. available at extra cost.

FOR HIGH SPEED MILLING, DRILLING, BORING AND COUNTER BORING ON ANY ANGLE





THE Halco Hi-Speed Universal Milling Attachment has proven its importance in building tools, dies, jigs, fixtures, wood and metal patterns and other machine products. Its 4-inch vertical travel permits many milling, boring and facing operations in one setup, a factor of convenience to which is added the advantage that the unit can be easily mounted by one man, it weighing only 90 pounds. Each head is unconditionally guaranteed for six months.

IMMEDIATE DELIVERY

(Designers and Builders of Fine Machine Tools)

SEND TODAY FOR FOLDER

AJAX ENGINEERING & MFG. CO.

MANUFACTURERS OF HALCO PRODUCTS

1947 E. KIRBY DETROIT, MICH.

Designing and Building
Tools, Dies, Special Machines and Parts

★

The illustration shows a section of our Engineering Department in which special tools, jigs, fixtures and special machines are designed for unusually wide diversification of industries.

A shop that is equipped—as we are—to see a job through from drawing to finished part, assembly or machine—is, like an individual, skilled, conscientious craftsman, able to get the job done most efficiently.

From our Engineering Department to our final inspection, our facilities in equipment and manpower have been built to render exacting precision service.

For years we have kept modernizing our equipment systematically.* We are able to meet many unusual demands that are now being made on contract shops.

**Send for circular listing our shop machines.*

THE BUNELL MACHINE & TOOL COMPANY
1601 East 23rd Street. CHerry 0343. **Cleveland, Ohio**

Tools and gages to your specifications

Accuracy to thousandths . . . . . Yes, even millionths. Our complete inspection laboratory is scientifically air-controlled. The elimination of temperature variations assures positive accuracy to your specification.

Master gages measuring millionths of an inch enable us to build jigs, fixtures, gages, and precision parts to the most exacting Army and Navy requirements. Have our experienced toolmakers with an Army-Navy "E" reputation solve your tooling problem. Our 24 years of experience will save you time and costly errors.

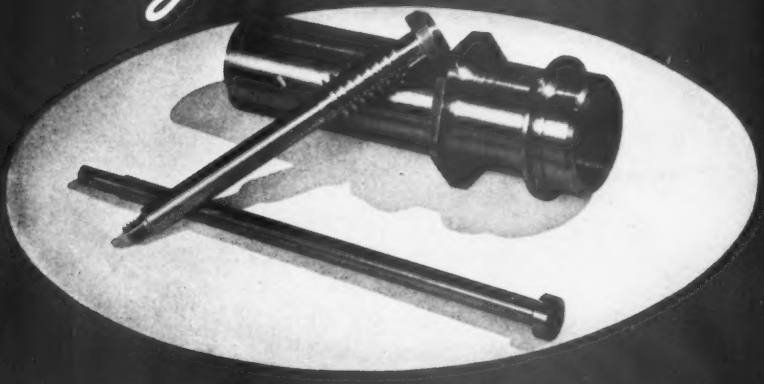
The most modern machines and tools for producing special tools, gages and ground threaded parts are available to manufacturers with war orders. Reasonably prompt deliveries can be made. Send blueprints for immediate quotation and delivery schedule.

ARMY E NAVY

TOOLS & GAGES, INC

3112 EAST 63RD STREET • CLEVELAND, OHIO

WILL YOUR DIE HEADS *do jobs like these?*



1⅝" Self-opening Head with Circular Hollow Mills

In the same rigid head, circular thread chasers are interchangeable with hollow milling cutters and blocks.

National Acme Engineers will gladly work with you on special or difficult hollow milling and threading operations.

NEW PRODUCTION RECORDS, for both precision and speed, are being made with Namco Circular Cutter Hollow Mills.

On a wide variety of end-forming and end-turning operations, these tools bring to many production plants important new advantages over single point milling tools—

1. Same "double duty" head used for both threading and end forming cuts.
2. Circular type cutters have 270° of circumference available for regrinding.
3. Cutters removed for grinding without disturbing setup, and replaced without changing precision in work.

Catalog D-42—sent on request—will bring you valuable help in saving time, increasing production, and reducing costs.

THE NATIONAL ACME CO.

170 EAST 131ST STREET • CLEVELAND, OHIO

ACME-GRIDLEY 4-6 AND 8 SPINDLE BAR AND CHUCKING AUTOMATICS • SINGLE SPINDLE AUTOMATICS • AUTOMATIC THREADING DIES AND TAPS • SCREW MACHINE PRODUCTS • THE CHRONOLOG • LIMIT SWITCHES • POSITIVE CENTRIFUGE • CONTRACT MANUFACTURING

Seeing and Solving PRODUCTION PROBLEMS

thru the Eyes of Manufacturers

Through experience on "the bench" and drawing board, followed by over 20 years of service in producing dies, tools, jigs and special machinery, McKinney approaches production problems *through the eyes of manufacturers.*

Not concerned merely with making parts and performing operations, the products of McKinney must and do fit into the over-all scheme of production — perform with *accuracy* to facilitate assembly — with *speed* to meet production schedules — with *economy* to assure necessary and justified profits.

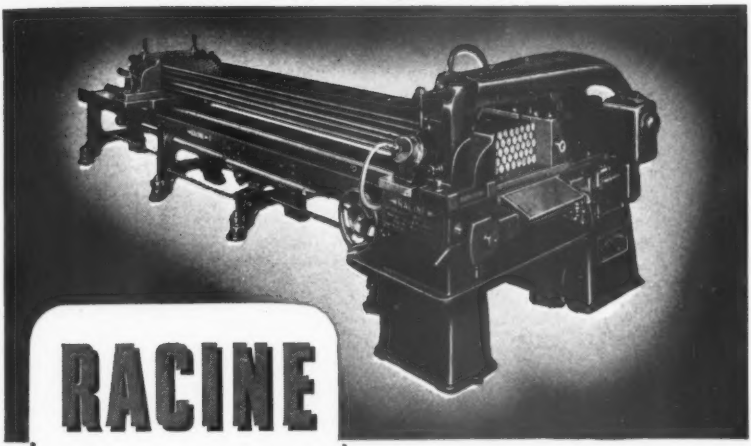
With experience and equipment second to none and expanded facilities, McKinney seeks opportunities to serve a few additional manufacturers who need this high standard of specialized service.

McKINNEY TOOL & MFG. CO.
CLEVELAND

DESIGN and PRODUCTION ENGINEERS
Since 1920

1673 ARABELLA ROAD

Tools · Dies · Jigs · Fixtures · Special Machinery



RACINE

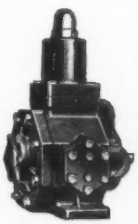
METAL CUTTING MACHINES

Standard for Higher Quality and Greater Precision

THESE Hydraulic Fed and Controlled Metal Cutting Saws with oil cushioned operation save blades, permit faster cutting and heavier cutting feeds. Designed and built for modern production—cutting time and costs can now be accurately determined.

Modern designing of Racine saws produces these outstanding features. Hydraulic control allows complete range of feeds—positive progressive and self-compensating progressive. Single lever control—inexperienced help can operate. Extra heavy pivot shaft and wide pivot bearing construction in arm of Saw Guide prevents cocking or binding strain in bearings and ways.

Racine's complete line includes models for general purpose and production cutting in a wide range of prices and sizes. Capacities 6"x6" to 20"x20" Automatic Stock Feed Machines, as illustrated, are also available.



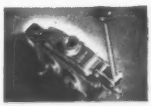
RACINE *Variable Volume* HYDRAULIC PUMPS

A Modern Source of Hydraulic Force

Speed up the production of your power operated equipment with Racine Variable Volume Oil Hydraulic Pumps and Valves. Pressure from 50 to 1000 lbs. per sq. in. for holding, pressing, clamping, feeding and forming operations.

No relief valve needed. Pump only the amount of oil you require to do the job. Exclusive "Vane Type" Variable Volume feature. For vibrationless action in modern machine design. Capacities 0-12, 20 and 30 gal. per minute.

Our Engineering Department will be glad to help you work out your hydraulic application problems. Address your request for complete information to Dept. TD-S.



Four-way Hydraulic Valves are available with stem, lever, roller, latch, foot treadle and solenoid operating devices. Various porting arrangements can also be furnished to suit requirements.

Racine's exclusive "Sleeve Type" Hydraulic Valves have balanced pistons. Made in ⅜" to 1½" standard pipe sizes. Continuous bearing and sealing surface—piston cannot sag—always in alignment—insuring longer valve life.

RACINE TOOL and MACHINE COMPANY

STANDARD FOR QUALITY AND PRECISION • **RACINE, WISCONSIN, U. S. A.**

Established 1860

DIAMOND TOOL COMPANY NOT INC.

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No. 1-ES 1/8x1/8
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No. 2-SR 1/8x2
No. 2-S-ER 1/8x2
No. 2-BS 1/8x2
No. 6-C-PG 45°x4
No. 4-C-VG 1/8x2
No. 4-C-EVG 1/8x2
No. 6-C-VG 1/8x2½
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SMALLER PLANTS AND WAR CONTRACTS

By
George J. Huebner*
Chief, Tooling Branch
Smaller War Plants Div.
War Production Board

NOT so long ago when our country was struggling to come up out of the throes of a severe depression, or repression as someone pointedly defined it, there was a considerable group of well meaning citizens who were certain that we had gone too far with our development of the machine and the mechanization of industry. As we look back over our experiences since the catastrophe at Pearl Harbor, we may well utter a prayer of gratitude that there existed then and continue to exist today the machines and tools we developed and the men we trained for mass production. Never before has a nation converted its resources and facilities to all-out-war so completely and in such a short time and in such tremendous volume as has the United States of America.

Today we hear on all sides that the period of time in which we may be able to win the war and particularly the cost in lives of the boys we send to the front are dependent to a large extent upon the technical genius and managerial abilities of men in industry. Colonel James L. Walsh, speaking recently before the Midwest Power Conference, defined our Nation's job as "getting the right number, of the right things, to the right people, in the right place, on time." That is indeed both a challenge and a responsibility necessitating the use, not only of all the Nation's manpower not required by the Armed Services, but also ever adaptable and qualified facility. To assist in this National effort, comes the Smaller War Plants Corporation, created by Congress under the Act known as Public Law No. 603.

The Corporation was given a capital of $150,000,000 for effectuating aid to smaller businesses. From this it may make loans or advances to such small business concerns or it may make purchases of facilities, machinery, materials and supplies to enable them to engage in production. The corporation is empowered to act as a prime contractor of "The United States Government and any department, agency or officer thereof having procurement power."

It goes without saying that the war has brought many very difficult problems to Washington for solution. I believe that this matter of assisting small business to fit into the complex war production picture is one of the most difficult. No one will deny the importance of these smaller producers in our National economy, but the very number that there are accentuates the difficulties. Nevertheless, I have seen

Text of paper delivered at
Spring Meeting
American Society of
Mechanical Engineers
Davenport, Iowa
April 27, 1943

In business life, Mr. Huebner is Publisher and Editor of The Tool & Die Journal.

progress made. One of my earliest experiences after having been called to Washington in September, 1941, was the locating of qualified facilities for manufacturing .30 and .50 caliber cartridge tooling dies, punches and gages. This was, in effect, the making of tools on a production basis. The contract tool and die industry and many small production plants with good tool room facilities rallied to the cause and shortly Government ammunition plants were provided with tools in abundance.

The appeal to prime contractors or to large subcontractors is one of the most logical procedures for smaller plant operators to follow to get business. It is still a selling job to win acceptance as a war production supplier, perhaps a more difficult job than ever. If no prime contractors are in a given area, the smaller plant operator must widen his circle to include more territory. The ease with which a plant fits into the war program depends primarily upon the urgency of the need for its facilities and the experience of its workers and management, and if the small manufacturer who has found the part or product needs financial assistance or equipment to round out the cycle of production operations, Smaller War Plants Corporation stands ready to help.

The Regional and District Offices of SWPC are staffed with men familiar with local problems and likewise with requisitions and specifications which pass through the Washington offices of SWPC on their way from the procurement agencies to the field. My Tooling Section in Washington recently had an interesting experience with such a requisition and it demonstrated not only the desirability of distributing war business among smaller manufacturers, but the downright necessity for it. One of the procurement agencies had prepared specifications for a large purchase of expendable tools, the total value of which was about $600,000. These were all standard tools and it was required that a substantial portion of the allotment be shipped within 90 days to some 16 different points from the Atlantic coast to Pearl Harbor. We were limited, therefore, to manufacturers thoroughly familiar with the production of such tools. Our investigation disclosed that the large manufacturers were quoting normally from 6 to 12 months delivery and that their backlogs of orders were considerable. By authority under Public Law No. 603 which created us, we elected to act as the prime contractor, agreeing to furnish the total tool requirements for not more than $600,000. We carefully surveyed the industry and found small plants which not only were in need of the business, but would be distressed to the point of laying off workers if they did not receive an allotment of the business. When bids had been received from the smaller manufacturers and the orders allocated, the results showed that we had purchased the tools for about $522,000, that we had placed business where it was seriously needed and, what is of equal importance, had relieved large manufacturers with order backlogs totaling more than $23,000,000 from dislocating their manufacturing schedules to make the shipments required within the first 90 and 180 days.

Perhaps I should have titled this particular experience: "American Free Enterprise in Action."

Smaller plants and businesses, in relation to our war economy, fall into two groups—those whose normal activities enable them to fit into war production quite easily and those for whom it is difficult or impossible because what they make normally just is not required.

The first group I have described. If they haven't until now obtained any orders or contracts it must be, at least partially, because they have not *sold* their facilities to prime and larger subcontractors. Colonel Robert W. Johnson who is chairman of SWPC's board of directors has said emphatically that it is the duty of big business to "take its share of the load to sustain small business." He continues: "By that, I do not mean that we are asking

big business to build up new competition against itself, but to keep the present competition at normal. If 20,000 purchasing agents decide this job should be done, that is all there is to it."

Even now there is in preparation by SWPC an advertising and merchandising campaign designed to bring together "businessmen who need products with businessmen who need production." Also the procurement agencies of our Government have been asked to report on the extent to which their prime contractors have let subcontracts.

The case of the misfit business or plant is more difficult but equally as worthy and here also SWPC stands ready to help by every means it may employ under the law by which it was created. Perhaps a case history, illustrating the extent to which owners and operators of difficult-to-fit-in plants have to go, will be interesting to you. I will quote from a letter:

"We probably are typical of many small plants. During the past few years, we did about a half million dollars of business yearly under another name. By last Spring we were out of business because of metal priorities. We then heard of a wood manufacturing plant that was ceasing to function after having been operated by the same management for two generations. It was the only business left in the community supplying employment. The town had relied on it exclusively for the past eight years. Previous to that there had also been a silk factory operating in the town which closed about 1934.

"Last June we proceeded to convert the wood manufacturing plant to war work and contacted the various procurement offices of the Army, Navy, etc., to secure the necessary orders to operate it. Later, when it appeared that it was going to be the policy of the Government to continue small plants in business where the management was willing to devote all of its efforts to Government work, as evidenced by your organization which was then being formed, we purchased the abandoned silk factory and converted it to war work.

"If we had not received the contract yesterday, we would have had to lay off over half of our employees today. This is a concrete illustration of how your efforts have continued employment in a small community which relies 100% upon war work."

Aside from the *actual* assistance which our Smaller Plants Organization has been able to give, I would like to have you realize that it has been a great stimulus to the idea that smaller plants are entitled to their place in the sun. The many activities of our organization have made the country small-business conscious. Two such specific activities are the Facilities Record Section and the Critical Machine Tools Service. The former has gathered and maintained the facility records of thousands of these small plants so that it might provide upon very short notice to the procurement agencies, prime and subcontractors, their records of machine tools—idle, available and qualified.

The Critical Machine Tools Service during the last six months has made it possible to absorb millions of idle machine tool hours in several thousand plants. In one instance, 16 hours a week on a horizontal milling machine removed a major production bottleneck. The other extreme is the assembling of some two million machine tool hours to handle a major part of a sub-machine gun order. It will amuse you to learn of one manufacturer who urgently appealed for time on screw machines. It was recommended that he use the idle time which his own plant had reported on exactly the machines he appealed for.

My own activities in Washington have been gratifying, often truly inspirational. Time and again we have been called upon by the Bureau of Ordnance of the Navy, or the Torpedo Stations, or Army Ordnance or some of their large prime contractors, to find certain seriously needed tools or accessories. We usually do not receive the call for help until the expediters all the way down the line have tried to get the tools from the plants where the orders had been

originally placed. It's a tough assignment then, but the willingness of smaller operators and the greater flexibility of their organizations have made it possible for us to place new orders and to obtain the much-needed deliveries. Such an incident occurred in the production of the M-I Carbine. Prime contracts had been given to five or six large manufacturers and they were absorbed in the many details involved in converting to gun production. Orders for tools, gages, dies, jigs, fixtures, cutting tools and all of the expendables were placed and usually with the larger manufacturers and tool shops. Priority changes frequently upset schedules in these large plants and in this instance tools were not forthcoming. We were brought into the picture by the Production Division of the War Production Board and the Ordnance Division of the Army. Here we developed a new procedure. An experienced tool man from my SWP branch, accompanied by an authorized buyer of the prime contractor, spread sufficient orders among smaller plants to obtain in less than two weeks partial but adequate deliveries of tools for the operation of a pilot line. It was comparatively easy then to swing into the full production as more tools were delivered.

Today we are hearing so much about the need for preserving the American System of Free Enterprise. This freedom has done for American Industry what the Four Freedoms have done for the American individual, in fact under its system we have the real answer to the individual's freedom from want. But we industrialists must make certain that it insures America's standard of living for the family of *every* man who works according to its principles.

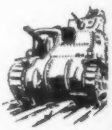
Our System of Free Enterprise is the small businessman's opportunity because under it he has the urge to develop his idea, the strength to follow it through, the opportunity to grow and expand. Creative effort usually stems not from him who has too much wealth nor from him who is struggling with poverty of thought or possessions. Under the advantages of Free Enterprise every man can reach his highest social value.

As I prepared to write this paper I stepped to my radio to turn it off. I was arrested by the announcement that four young men were about to debate the question of whether or not American youth should support competitive free enterprise as our dominant economic pattern after the war. A few of the observations of these intelligent members of the younger generation interested me and I think they will you also.

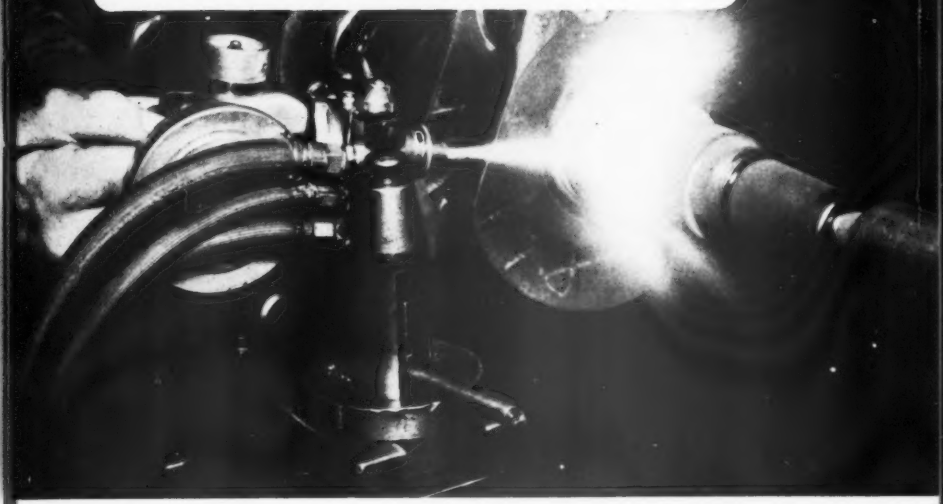
One said that maximum and continuous employment after the war is youth's *demand*. But another stipulated, "When I return, I want to know that I still have the right to compete" and that competition will be kept fair to prevent monopoly and harmful collusion. Still another made the brutally frank statement that a man must not be chained to his machine with an inadequate income under the threat of unemployment.

These are the viewpoints of some of the boys we are sending overseas and they compel the consideration of you and me, for as I wrote in an editorial recently: "We have sent our sons and our neighbors' sons to the battlefronts and some day many of them who gave up jobs, careers and businesses will return and they will ask for an accounting. Let's be certain that accounts balance."

After the war there will undoubtedly be a period of readjustment when many men and businesses must re-establish themselves, but if we can carry on our war effort with such vigor that we bring the outlaw nations to their knees not later than next year, there should follow, after a not too difficult readjustment, a period of tremendous industrial activity. There should then be great opportunity for every legitimate business, large and small, and when that time comes, I feel confident that many a Smaller War Plant owner or operator will recall gratefully the help he had from Smaller War Plants Corporation. In closing, may I express a conviction that the future belongs to those men and companies who prepare for it today.



METALLIZING IS SAVING VITAL WAR MATERIALS



L. E. Kunkler

President

Metallizing Company of America

TODAY Metallizing, a method of salvaging worn metal parts, is playing a big part in our Victory drive to conserve vital war materials. It is also eliminating many costly periods of shutdowns in industry and effecting drastic reductions in mechanical maintenance costs. Such repair and salvage can be done by relatively unskilled labor at low cost.

The worn parts of machines, ships, planes, automobiles, trucks, railroads, buses, etc., are today being built up quickly and economically through the metallizing process. Metallizing can be used in place of tinning, galvanizing, calorizing, electroplating and welding under certain conditions. In most of these processes there are definite limitations as to the size of the job which can be treated. There are also certain limitations as to the metals which can be used. Metallizing, on the other hand, has none of these draw-backs nor is there any danger of distortion due to heat.

Metallizing is not an experimental process. It has been developed and improved over a period of years. It is, however, considered a modern way of building up worn parts, improving operating surfaces and making exposed areas corrosion resistant and hard surfaced.

In metallizing, the metal to be sprayed is fed in wire form into the back of a

gun and a 3½" diameter balanced turbine propells the wire with uniform speed. The wire is led into the nozzle where it is melted by either acetylene, propane or generated gas flames combined with oxygen and the molten metal is discharged from the gun in a microfine spray by air pressure. This steady wire feed, together with the proper heat and air pressure of the gun assures higher speed operations as well as a finer, denser deposit which makes the metallized part more readily machinable.

Preparation of the Part for Metallizing

In preparing the part for metallizing it is necessary that the proper metal be chosen for the service involved. If service requires both wear and corrosion resistance, then 13-16% chrome steel wire will be the best to use. If wear alone is the important consideration, either a 1.20 percent carbon steel or a 1.00 percent carbon and 2.00 percent chrome steel wire will be satisfactory. Where corrosion alone is the factor, either stainless steel, one of the bronzes, or a high carbon iron can be used depending upon the chemical condition encountered. Once the best wire to use has been determined, the part to be metallized is placed in the lathe and the trueup cut taken over the entire length of the worn surface, overlapping at each end about ¼ inch, so there will be no joint coming under the packing. The cut should be deep enough to allow for future wear without exposing the base metal. On rods one inch diameter or more it is customary to under-cut $\frac{3}{32}$ of an inch on the diameter. For smaller rods this can be reduced to $\frac{1}{16}$ inch. It is important that the rod is cleaned with emery cloth for a distance of about one inch beyond the under-cut section. Likewise, the shoulder at each end should be squared, using a cutter-off tool. The bottom of the piece at this point should have a small radius to prevent any tendency toward starting a crack.

Rough Threading

One of the methods for preparing a part for metallizing is known as the Rough Threading method. An ordinary threading tool which has had the side clearances ground away and the point slightly rounded is used. The point of the tool is set about $\frac{1}{16}$ inch below the center of the rod, and with the spindle speed reduced by the back gear, a thread is run the entire length of the under-cut area (24 threads per inch). The object of this operation is to obtain a thread with a smooth bottom and well torn sides giving thousands of interstices for sprayed metal to adhere to. Not all al-

(Continued on Page 192)

Fig. 1—Above: non-bonding (dark areas) using the Knurling method. Below: bonding after threading treatment.

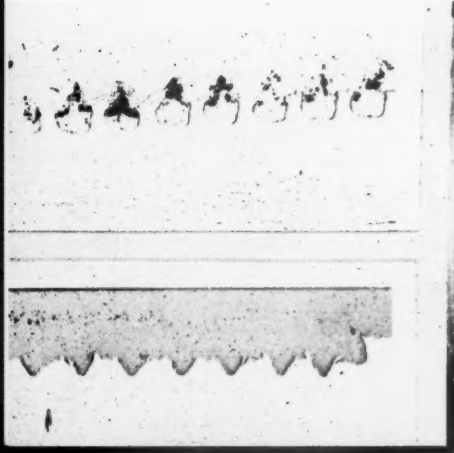
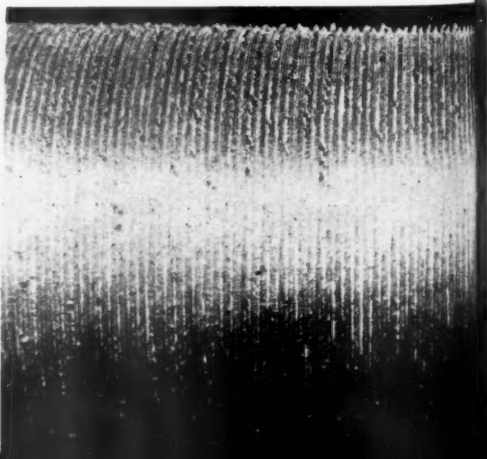


Fig. 2—A thread turned on worn surface with lathe tool set slightly off center to produce a tearing effect.



MODERN MILLING FIXTURE DESIGN

C. W. Hinman
Designing Engineer

CONNECTING rods for aircraft motors must be precision made. Especially is this true of those used in "fighters" and "bombers," which must be finished to an infinitely greater degree of accuracy than the connecting rods used in any other type of internal combustion engines. First of all, a rough steel forging of special alloy is used. The rods must be carefully machined and finally ground and polished all over; the polished finish favors an easy flow of lubrication when the connecting rods are in action. Further, each connecting rod must be finished to an exact weight. They must be of equal weights within astonishingly close limits and the bearing surfaces are lined with pure silver. These specifications, together with others which are too many to enumerate here, improve lubricating conditions, increase aircraft speed and maneuverability, reduce shock and vibration and add immeasurably to the improved action and life of the motor.

Milling Flat Sides of Connecting Rods

The first milling operation on connecting rods is to machine finish the flat sides. The "flats" are at both ends and on both sides of the piece around the bearing bosses. After the bosses are finished, it is possible to register the piece from them in other fixtures for subsequent milling, drilling and boring operations.

Figure 97 shows two milling fixtures set up for end milling both ends of connecting rod on the bosses of four rods in one setting. The method used comprises two hand-clamping fixtures mounted on the table of a plain hydromatic milling machine which the the "bridge type" vertical head and two cutter spindles. Each fixture holds two pieces of work and the operation is called "string milling" because the fixtures with the work pass under the cutter heads, one following the other. This idea provides space between the fixtures and the necessary time to reload one fixture while the other one is still under the process of milling.

Two cutters are used. One cutter is a 3" diameter shell end mill, as shown attached under the front spindle in the bridge. The other is a 6" diameter end mill attached under the rear spindle. Both of the cutters have inserted teeth with cutting edges of sintered carbide.

The body of the fixture is a "husky" semisteel casting with a ramp that leads away from under the work to dispose of chips and oil. The small end of the connecting rod is centered in a V-block

Fig. 97

opening at the front of the fixture. The work is forced into the V-block by tightening the screws shown near the bottom of the fixture in the foreground. These screws operate a horizontal thrust-rod that moves out the tail on a fulcrum pin clamp in the rear of the fixture. The top of the clamp is caused to grip the work and push it forward into the V-block. A side clamp, outside the fixture at the rear, carries a set screw which, when tightened, clamps the large end of the work sidewise against an opposite stop. A copious amount of lubricating coolant is supplied to each cutter by the pipe and hose connection shown on the right side of the machine.

The finishing specifications are: "good commercial" and the thickness tolerance is plus or minus 0.001". Speed of cutters 64 rpm, feed 3½ inches per minute, output 19 per hour.

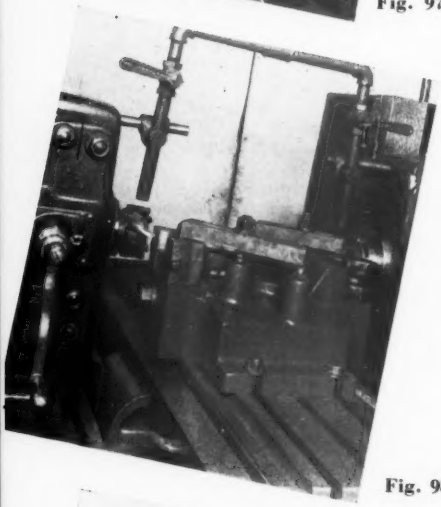


Fig. 98

Milling the Parting Faces on Connecting Rods and Caps

Figure 98 illustrates the fixture and setup for end milling the parting faces across the ends of a connecting rod and its corresponding cap. This is also an aeronautical job. The milling machine is a duplex type having two opposed cutter heads with the table between them.

The connecting rod is shown at the left front in the fixture and the cap is on the opposite side of the fixture and at the right. Tool steel hardened and ground wear plates under the connecting rod in the fixture and a hardened angle are positioned on two sides of the cap, to take the wear. Two 5" diameter cutters, provided with inserted teeth of high speed steel, are used. The connecting rod is located over a pin in the fixture; the pin passes through a hole in the small end of the work.

Slotted clamps, with compression springs under them, raise the clamps for removing the work when the nuts over the clamps are loosened. The same nuts cause the clamps to grip the work when they are tightened down with a wrench.

Fig. 99

This setup is a simple two-station hand clamping fixture provided for mill-

(Continued on Page 183)

The purpose of this article, and others to follow, is to stimulate constructive thinking on the application of tooling and production developments as they affect the fabrication of post-war products. The dream cars, airplanes and radios of the future are being born in the Nation's tool shops, production plants and arsenals. The future belongs to those men and firms who plan for it today.

PLANNING PEACETIME PRODUCTION IN WARTIME

By H. O. Bates

TO the patriotic American it may seem that the development of peacetime production in wartime is definitely not the order of the day. By some it may even be considered sabotage of needed war effort. The purpose of this article is to illustrate that wartime planning for peacetime production will not only ease the shock of returning to normalcy, but will make our present war effort more effective.

Army and Navy strategists agree that a plan of attack without a plan of retreat may bring disaster. This is equally true in industry's tooling and production battle.

A novel example of dual planning was the development of the British tank during the last war. It became in a few short months the Caterpillar Tractor, an agricultural implement that replaced the draft horse in many parts of our country, the Argentine and Russia and to a lesser extent throughout the world. It has proven an equally important machine in the construction industry.

The airplane, the automobile and many other machines have used the battlefield as a proving ground to the advantage of a peacetime world.

Isn't it reasonable to assume that a compressed air gun may be developed in wartime that will fire shells at the enemy without the aid of explosives and after the war, the same gun may be used for firing pellets into veins of coal, iron ore or limestone to break down the raw materials for industry?

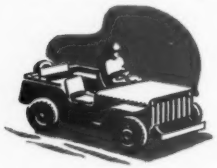
Research, tooling and production engineers are rapidly moving forward the frontiers of industrial opportunity. Electronic controls, currently being developed with amazing results, will have their decided effect in a post-war world.

New hard metals for cutting tools are now being used to meet our urgent military requirements. Machine Tool Designers are completely revolutionizing machine designs to use these new expendable tools more effectively. The development of light metals, aluminum and magnesium for aircraft production will also influence peacetime production design. Magnesium, which is 40 percent lighter than aluminum, will shortly be in production at a volume twice as large as the amount of aluminum produced in 1939. Such rapid strides in material and fabricating technique will produce radical changes in the post-war automobile. It will be possible for the aircraft designer to apply

his newly acquired techniques to the design and production of consumer goods.

In the field of aerodynamics, many new functional problems are being solved. Old axioms are being revised as plane speeds are equaling and, in some instances, passing the speed of sound.

Other means of propulsion must be used when propellers are no longer efficient. Anti-aircraft development has brought about high altitude flying, which completely revolutionizes plane designs. Their post-war advantages of rapid speeds and low fuel consumption are apparent. In the field of synthetics there have been so many developed that some manufacturers who adopted them for substitutes will never again return to their old sources.



Metallurgy has kept pace with synthetics, with the development of many new alloys formerly too expensive for industrial use. Glass has developed more in the past few months than in several decades, not only in optical glass, but also in new uses that had never before been considered. Glass gages are a typical example. These are a few illustrations of dual planning in industry. There are dreamers who believe that at the war's conclusion there will be made available automobiles produced entirely from plastics, except for the engine and frame, or entirely of light metal; that there will be complete air conditioning units and running ice water in every home; that we will have television sets and electric ranges that will roast and bake by radiant heat. We have all seen these ideas illustrated by the Sunday magazine artists. This is, of course, futuristic ideaology instead of thinking and designing in terms of a sound immediate post-war era.

The possibilities are almost limitless, but people do not readily accept radical changes. Neither can manufacturers completely dispose of their wartime equipment. They must base their new products on the manufacturing processes developed now, which gives added emphasis to a program of dual planning.

It is still reasonable to assume that 90 percent of the post-war production will be accounted for by products which were in more or less general use before 1940. This in no way reflects on our researchers or inventive geniuses, but food, clothing and shelter will still be popular and the peactime developments of electronics, light metals, dehydration and aerodynamics will be given an opportunity to play their part in building a better world and a higher standard of living.

Our particular thought has been focused on the peacetime possibilities in the design and operation of marking equipment. In Revolutionary and Civil War days high production of duplicate parts was as yet unheard of. Even as late as 1880 gun parts were produced without specialized tooling and the parts tediously selected and fitted together by hand. Today, each part bears a blueprint number, labeling it as a perfect replacement. This development makes it possible for a supply officer to radio his base "rush 2,000 parts, No. X-1033" knowing that they will fit perfectly. We realize that when the same officer resumes his peacetime position he will be familiar with the advantages of ordering by number. By planning today, those same wartime machines can be quickly altered to fill an important place in peacetime. They also will have been tested on the production battlefront.

Although our present production is basically for the purpose of destruction, it is also a means for ultimate victory. When the enemy has unconditionally surrendered, industry will be able to turn these same forces to an effective peaceful purpose.

Mr. Bates is President of The Acromark Company, Elizabeth, New Jersey

STEEL CARTRIDGE CASES

R. B. Schenck
Chief Metallurgist
Buick Motor Division
General Motors Corporation

With the critical shortage of copper, the main constituent of brass, growing steadily more acute, it became obvious to industrial and government engineers that the development of a practical method for the production of steel cartridge cases in virtually all calibers was an actual "must". Buick, together with a group of other manufacturers, has worked closely with Ordnance, and shortly, steel cases will be in volume production.

The original work was done on an extruding die about one-third the size required for a five-inch Naval case. Preliminary efforts were mainly concerned with meeting dimensional specifications rather than physical properties.

The first extruding die worked satisfactorily, so experimental redraw and

Editor's Note: Buick is one of three firms using the hot cupping process. Completely cold working throughout fits the facilities of the majority of steel shell producers (over 50). These operations will be discussed in a coming issue, giving readers a fair understanding of the whole program. It is easy for the tool or production engineer to imagine the post-war applications of both developments.

Fig. 1—Forming operations from bar to finished case.

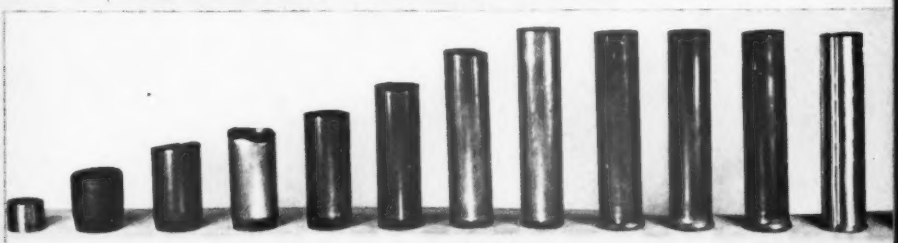


Fig. 3—Hot extrusion.

Fig. 2—Induction heating for extrusion.

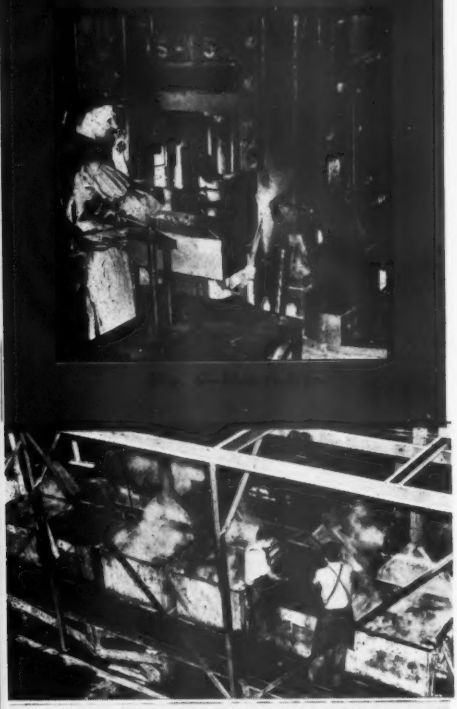


Fig. 5—Bonderizing treatment.

Fig. 6—Press for the four drawing operations.

Fig . 7—Heading operation.

heading dies were made and the first case was produced. The Buick Management was favorably impressed with the sample case and submitted it to Naval authorities who asked that development continue. Work was started on tools to carry a three-inch steel cartridge case through the redraw operations. The three-inch case was adopted because experimental work could be carried on faster with this than with the five-inch size. While this work was in progress other meetings were arranged with both Navy and Army Ordnance personnel. In November, 1941, the Army requested Buick to develop the 75 millimeter case while the Navy decided to be guided by the Army developments. This was the beginning of the Buick program on the 75 millimeter steel cartridge case.

Mechanical Requirements

The purpose of a cartridge case is to act as a container for the explosive charge, to prevent the escape of gases resulting from the explosion, and permit more rapid firing than would be possible without fixed ammunition. The wall of the case must be elastic enough to expand under the explosive pressure and make a tight seal against the breech wall of the gun. Unless it is properly supported by the breech wall, the pressure developed is sufficient to burst any case. A certain amount of clearance is necessary between the cartridge case and the breech wall to permit ease of loading and ejection under field conditions. The cartridge case must expand, first to take up this clearance, and continue to expand as the breech diameter increases due to the explosion pressure. The case must have enough elastic recovery to allow easy ejection after firing. In contrast to the high physical properties required in the body of the cartridge case, the mouth must be annealed to insure complete obturation.

It is necessary to have a higher yield strength on a steel cartridge case than on brass because of the higher modulus of elasticity of steel. The modulus of brass is 14,000,000 against 30,000,000 for steel. The stress within the elastic range to produce a given amount of strain in brass is therefore approximately one-half that of steel. Other considerations

are corrosion and sparking which must be overcome by suitable protective coatings. The steel cases must be interchangeable with the brass. They will function equally well in service.

Metallurgical Requirements

The required physical properties of a steel case can be obtained either by cold work alone or by quenching and tempering before or after cold working. Cold working alone involves the least number of operations, fewer shop problems, less equipment, and has been found adequate. Quenching after cold working results in distortion of the case which must be controlled by intricate quenching dies or by additional sizing operations. Quenching followed by cold working eliminates the distortion problem and has been employed successfully on experimental lots. Where cold working alone, or quenching before cold working is employed, a final stress relieving treatment should be used to further improve the physical properties.

In the selection of a material, a low carbon steel was chosen which could be cold-worked and stress relieved to the required physical properties without resorting to a spheroidizing treatment prior to cold forming. Among the compositions tried during the development were S.A.E. 1015, 1016 and 1020, A.I.S.I. C-1019, and a higher manganese type containing .20 carbon and 1.29 manganese. Experimental lots of C-1019 included coarse grained, fine grained, aluminum killed and silicon killed steels.

The composition finally adopted, and now in production, is an open hearth, high manganese, aluminum killed, fine grain carbon steel.

Of utmost importance is the physical quality of the raw material. Best mill practice with regard to discard, surface conditioning and macrostructure is essential in producing suitable steel for cartridge cases.

As in all structural applications where stress is involved, the material in a cartridge case must possess a certain combination of strength and ductility for successful performance. In the side wall of the case, with exception of the mouth, the yield strength must be high enough to prevent a degree of permanent set sufficient to cause difficult ejection. Also, the ductility must be adequate in all sections to prevent rupturing from the explosive pressure.

Manufacturing Operations

The following is a list of the major operations performed in the manufacture of the 75 millimeter steel cartridge case at Buick:

1. Cut Off
2. Grind O. D.
3. Heat
4. Extrude
5. Redraw Hot
6. Size Cold
7. Anneal
8. Pickle and Rinse
9. Coin Head
10. Bonderize
11. Draw
12. Trim End
13. 1st Cold Redraw
14. 2nd Cold Redraw
15. 3rd Cold Redraw
16. Trim End
17. 4th Cold Redraw
18. Bonderize
19. Cold Head
20. Flame Anneal
21. 1st Taper

Fig. 11—Automatically trimming steel cases.

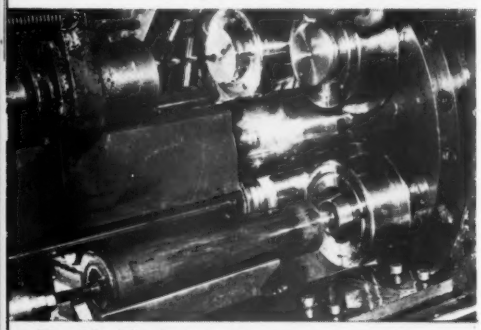


Fig. 12—Machining base on automatic.

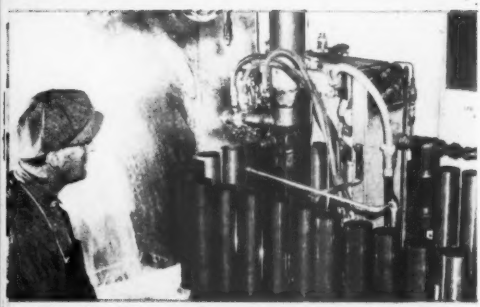


Fig. 13—Fixture for spraying phenolic varnish.

Fig. 14.—Checking case dimensions.

22. 2nd Taper
23. Flame Anneal
24. Machine Base
25. Face to Length
26. Finish Ream & Counterbore
27. Inspect and Repair
28. Draw
29. Phosphoric Acid Pickle
30. Paint
31. Bake

The appearance of the case at various stages of manufacture is shown photographically in Fig. 1.

It has been standard practice to start with the three-inch blank to form the 75 millimeter case, but experiments indicated that by starting with a somewhat larger blank, it was possible to get a better filling of the dies in the hot operations. Hence, the blank was increased from 3 to 3⅛ inch diameter, although this meant no essential change in the method.

The centerless grinding serves to provide a more perfect surface, eliminating defects which would tend to carry through the subsequent operations.

Heating for the hot cupping operation is done in a specially built induction heater, the piece being brought to temperature in 1½ minutes. See Fig. 2. The machine has two fixtures which may be operated simultaneously, permitting a production rate of eighty pieces per hour. During the brief period of heating, a yellow gas flame is directed onto the steel, enveloping it and preventing scaling. The current kicks off when the piece has been brought to temperature, and it is then transferred to a gas fired muffle furnace where it is held for seven minutes to insure an even temperature throughout the steel. This set-up is only temporary. Two new induction heating units are on order which will eliminate the soaking furnace.

The extrusion is done in a standard forging press of the crank type common to many automotive shops. See Fig. 3. On this press, the upper die member is a hot die steel punch, nitrided for improved wearing qualities and rounded at the end to form a smooth radius at the base of the cup. The lower die has a cavity the size of the formed cup, or virtually the same diameter as the heated blank. The punch extrudes the blank from 1¾ inches to about 4 inches.

(Continued on Page 195)

FLAME HARDENING STEEL DIES

Unique Development for Longer Die Life

C. W. Derhammer
President
The Lakeside Steel Improvement Company

OUT of this war period has come a development in the treatment of die steels that has saved many thousands of man hours, much critical material and a great deal of money. Die makers and die users alike have profited. This development is the use of flame hardening in the production of steel dies.

Flame hardening now serves the die maker in many ways. With it, he can harden the wearing parts of a die without touching other sections and make a new die wear longer or put new life in an old die. Certain areas may be treated to eliminate possible distortion and cheaper and more plentiful types of steel can be substituted for rich, alloy die steels, with the same strength and service possible from the dies.

Flame hardening of dies has been practiced for many years but its full worth was not completely appreciated until recently when die steels became scarce and the length of time required to manufacture dies from these rich alloys became such a bottleneck in the production of war material.

But with all the points in favor of flame hardening it should be remembered that this process is not presented as a "cure-all" for the problems of die makers and users but rather as a great help in saving time and money in the production of dies and as an aid to increasing the life and service of present dies with little additional expense.

Flame hardening tends to minimize distortion but in the case of die steels there can be little or no distortion. Distortion is greatest when only one side of a thin object is heated and quenched. Often it is found that a water bath or a compensating heating on the opposite side from which the flame hardening is being done will hold distortion to a minimum. In sections of a die where both sides can be hardened simultaneously, distortion is nil.

There are several methods under which dies may be hardened and all require high skill and careful preparation to attain the proper results. The equipment for this work plays an important part, particularly the torches and tips. Hand operations should be used as little as possible, because mechanized flame hardening is more uniform and more economical.

For progressive flame hardening, the tips should have integral water quenching jets at the proper distance to the rear of the heating flame. These progressively quench the surface as it is heated. The water jets serve both to quench the hardened part and to cool the tip. For operations where the surface is heated and quenched separately, it is found that a tip with internal cooling is best.

Tempering or stress relieving is absolutely essential to successful flame hard-

ening and should follow shortly after hardening, with a temperature sufficient to relieve the stresses set up by quenching. This temperature must be carefully checked to see that it has no effect upon the hardness.

Flame hardening of steel dies sometimes appears simple to the inexperienced but it is far from that. There are any number of variable conditions which must be regulated and co-ordinated to insure the most satisfactory results.

(Continued on Page 215)

Fig. 1—A Mechanite forming die being flame hardened, replacing critical tool steel.

Fig. 2—A forming die flame hardened at the greatest points of wear.

INFRA-RED IN INDUSTRY

Paul H. Portteus

INFRA-RED is fast becoming one of the most important of the modern tools in industry. It is changing hours to minutes, and altering temperature conceptions in present day processing.

Today, specially engineered infra-red heaters are working wonders in hundreds of applications. They are helping to eliminate bottlenecks in the production of guns, airplanes, motors, engines, tools, castings, plastics, textiles, synthetic rubbers—as a matter of fact, wherever heat is required—infra-red heaters can be and are being used.

Infra-red heating systems are winning favor because of the many advantages they offer over other systems. Infra-red heat penetrates to the core, thus assuring even, uniform heating. It is quicker; it requires less space than ordinary heating equipment; and it demands a lower investment, both in initial costs and in operating and maintenance expenses. There is no stand-by loss—infra-red energy can be turned on and off as needed without loss of power or product, and no oven preheating is necessary. The equipment may be moved easily and adjusted quickly to accommodate a variety of products, thus giving greater flexibility. Infra-red heating permits continuous visible inspection. With it, there are no hot blasts of air, no heavy atmosphere, no high temperatures in the surrounding room. Furthermore, infra-red equipment has an exceptional safety record.

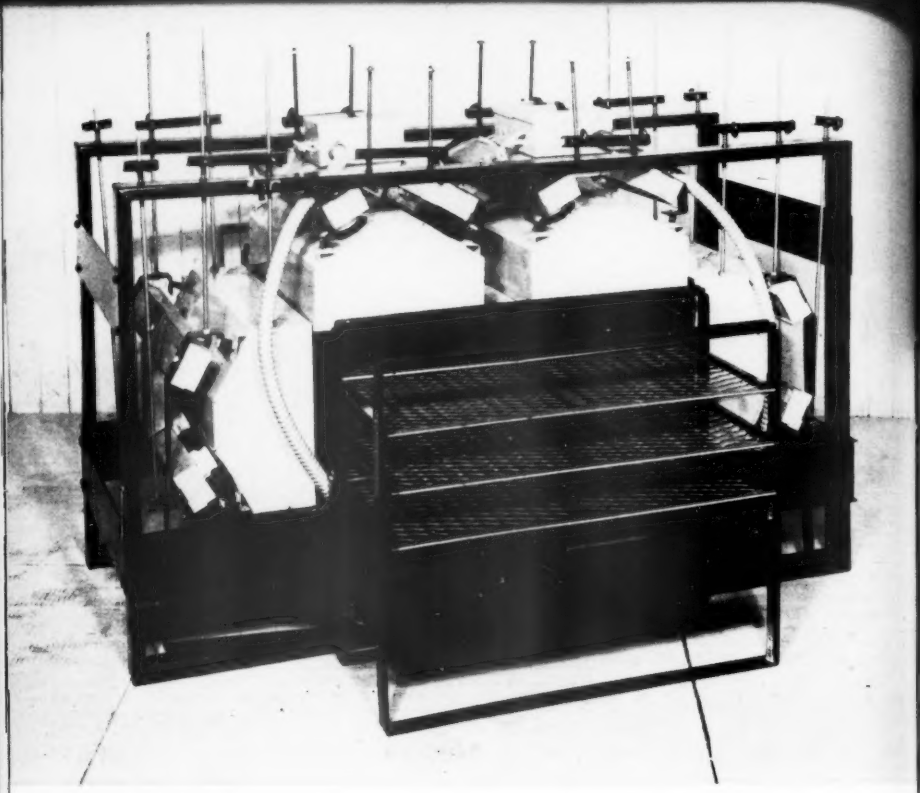
The information in this article is supplied by Infra-Red Engineers, Inc., 812 Huron Rd., Cleveland, O. Further details can be obtained by writing to the company.

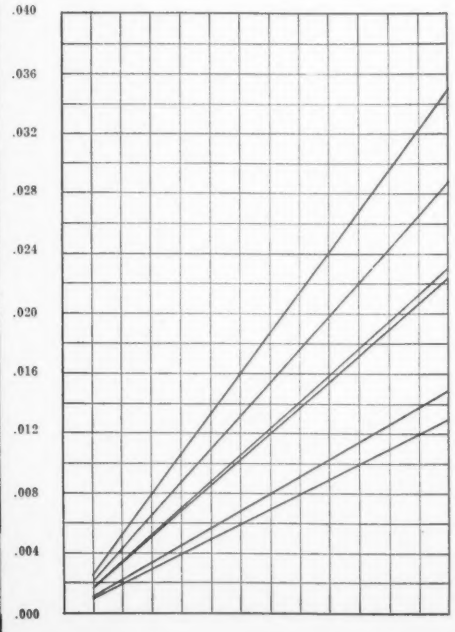
Pre-war close limit gages were made from high quality steel which had been naturally aged to stabilize "growth" by exposing to the elements for eighteen months to two years. Weather cycles, changing from day to day, cold in winter, hot in summer, set in motion inherent forces within the steel, causing "growth" to take place. Gages formed from this stabilized steel, however, maintained their true dimensions (barring wear) for years.

At the beginning of the rapid expansion of the gage industry, to meet the heavy demand for gages by the United States and other United Nations, the stock pile of such aged steel vanished. Only "green" steel was available for gage making. It was then that experiments with artificial aging were carried on, and from these experiments was developed the process now used almost universally (with variations) by gage makers.

The process is applied after the rough grinding operation, when the part has been finished to about .002 limit, and generally utilizes both heat and cold. The most popular method is to subject the unfinished gage to sub-zero temperatures for about eight hours (depending on the mass); warm slowly to room temperature; raise to 200 or 250 degrees F and soak for about eight hours; cool slowly to room temperature; soak again at sub-zero temperatures for eight hours; warm slowly to room temperature, and then finish grind and lap. Gages stabilized in this manner seldom change size with age (barring wear).

The cooling cycle may be accomplished with solid Carbon Dioxide (Dry Ice), or mechanical refrigeration. The heating cycle has been accomplished in any equipment available, capable of producing the required heat. The original process called for heating in hot oil, but some manufacturers have lately been investigating the use of especially designed infra-red heaters. The cleanliness of the new method especially recommends





Expansion of metals at a temperature rise of 180° F.

the new method especially recommends it. Gages are subjected directly to the infra-red rays, in atmosphere, without use of oil. The penetrating effect of the infra-red rays heats the entire mass uniformly — a much desired effect.

With the conversion of American Industry to war production, there came a revision of the precision standards in use in assembly operations. Force fits, generally specified, gave way, in many cases, to expansion, shrink and compound fits. These provided more positive fits than pressing, as evidenced by the fact that expansion, shrink, or compound fits require more pressure to break the fit than do force fits assembled from parts of the same size, having the same allowances.

Expansion fits require cooling

(Continued on Page 205)

ORGANIZING A WARTIME Safety PROGRAM

By Ned H. Dearborn,
Executive Vice President
of the
National Safety Council

IN ordinary times plant safety programs show up black in the company books and make for healthy personnel relations.

In time of war, however, plant safety becomes obligatory, a national responsibility tied in with the struggle to conserve every bit of available manpower on the home front.

Accidents are levying a tremendous toll on American productive capacity. Last year 47,500 workers were killed by accidents, 4,100,000 injured. Lost time through non-fatal injuries to workers was alone equivalent to a shutdown of the Nation's entire shipbuilding and aircraft industries for 54 days. A country at war cannot, of course, tolerate such wholesale sabotage.

Large scale programs reaching into every field of accident-prevention — in industry, on the highway and in the home—are being put into effect by the National Safety Council at the request of the President of the United States.

It is to finance this program that the Council's War Production Fund to Conserve Manpower has been formed. William A. Irvin, immediate past president of the U. S. Steel Corporation, is the national chairman of this Fund organization, which is now engaged in raising $5,000,000 in voluntary contributions from business and industry to support the great expansion of Council activity.

As the Fund grows the Council is rapidly organizing safety activities in war production centers and in agricultural areas, aiming at year-round programs in every industrial center and farming region in the United States. The Council is co-operating widely with public and private agencies touching every phase of American life.

The Council's wartime safety program for America emphasizes that a successful accident prevention program must consider safety off the job as well as safety at work—for three out of five accidents to workers happen off the job. The primary aim of the Council, however, is a plant safety program in every one of America's 196,000 industrial establishments. As things stand now, only one out of eight plants is properly protected.

Many plans have been worked out for the prevention of industrial accidents. But regardless of the size of the plant, of whether it is a metal working plant or one manufacturing cement, long experience has led the Council to believe that the following eleven essential steps must be carried out. Once the program is under way and begins to develop, it will be necessary to elaborate and specialize, of course. But the eleven steps are basic in any industrial accident prevention setup.

The first step is to get the management solidly behind the project. Safety must start at the top, at the seat of authority and control, working downward through superintendent and foremen to the employees. The management must convince workers by visible evidence, in the form of mechanical guards, good lighting and so on, that it is doing

its full part, before the worker can be expected to take safety disciplines seriously.

What applies for the management goes with equal force for the superintendent. He heads the field troops, so to speak, in the safety campaign. Success depends greatly on his enthusiasm and backing. Converting the superintendent to the safety point of view is, then, the second step.

The third step is to establish and maintain capable direction of the safety program. In the small plant the manager himself should assume safety as a definite responsibility. In the larger plant, one individual should be assigned as safety director, either on a full-time or part-time basis. But whether the manager himself takes over, or someone else is assigned to the job, the important thing is that safety should never be considered a casual sideline. The employees' co-operation cannot be so easily won.

A good safety director's qualifications are vision, initiative, diplomacy, judgment and, above all, sympathy. These qualities are perhaps even more important at the outset than his purely technical safety knowledge, though of course he should be thoroughly familiar with the operations of the company.

Above all, the safety director must know how to sell himself and his program. For example, he must be able to convince management of its responsibility for providing mechanical safeguards when designing or buying equipment. He must be able to develop a safe working environment in the plant.

In some plants the safety director will have charge of all employee relations; he will hire, judge grievances, and look out for sanitation, health services, recreational activities and so on. When this is not the case, the safety director should keep in close touch with the department which does have these responsibilities. Today it is generally realized that without a full knowledge of the employee's background, the complex chain of circumstances and personal peculiarities that lies behind every accident can never be opened up and a recurrence prevented.

The fourth step is for the safety director to analyze the plant's accident experience for at least two years past. He must do this to become properly oriented in the situation. An orderly analysis is also a powerful weapon in convincing skeptical foremen of the seriousness of accidents in the production and morale picture.

A safety meeting of operating executives is the fifth step. All supervisors, foremen, superintendents and operating heads should attend, and the meeting should be presided over by the manager or the general superintendent.

At this meeting the safety director is officially introduced, and the gathering acquainted with his accident analysis of the plant and plan of attack. The responsible executive of the plant should make it clear that the safety director has an important job to do, that he is expected to make serious recommendations meriting serious attention.

Following this meeting the sixth step is to make a complete inspection of the plant. Foremen should be given initial aid in filling out the standard inspection forms provided for their use, but this help should not go beyond simple guidance. From the start the responsibility for keeping a running account of the safety situation must be placed directly on their shoulders. Typical points to be covered on this inspection are: fire and fire protection hazards, ice and snow hazards, yard and electrical hazards, hazards at the machine point of operation, power transmission hazards, material handling hazards, chemical, lighting, ventilation and housekeeping hazards.

On the basis of this inspection, which should be repeated at regular intervals, the program of mechanical safeguarding should be started as the seventh step. Recommendations made by the foremen in their reports should be discussed with the superintendent, not only to judge their validity, but to familiarize the superintendent with the whole plant safety situation.

The eighth step is to provide facilities for giving first aid. In the smallest companies it may suffice to provide a first aid kit and to have at least one of the regular employees trained in first aid techniques. Larger companies should set up a special first aid dispensary, clean, well-painted and well-appointed, with stretcher, bed, splints, bandages

(Continued on Page 119)

UNIVERSAL TOOL AND CUTTER GRINDER

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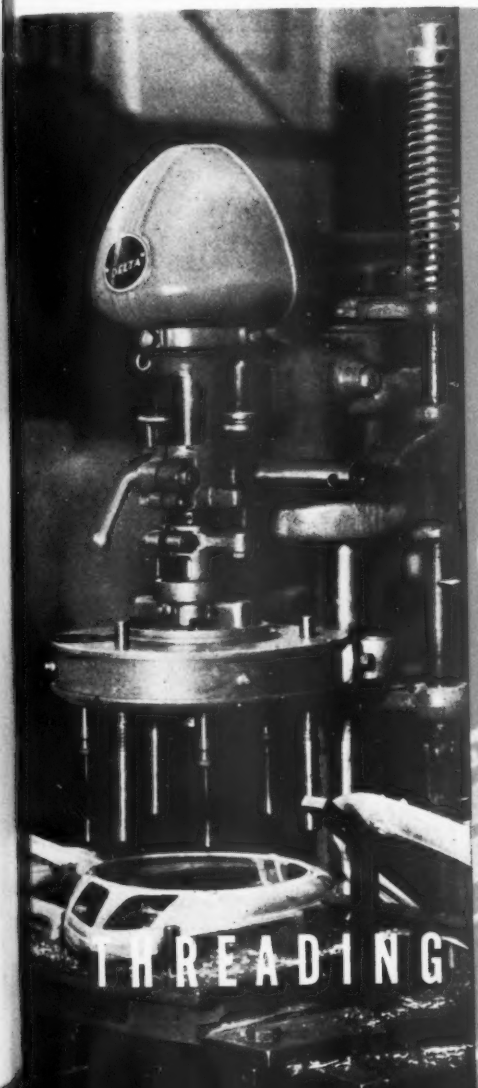
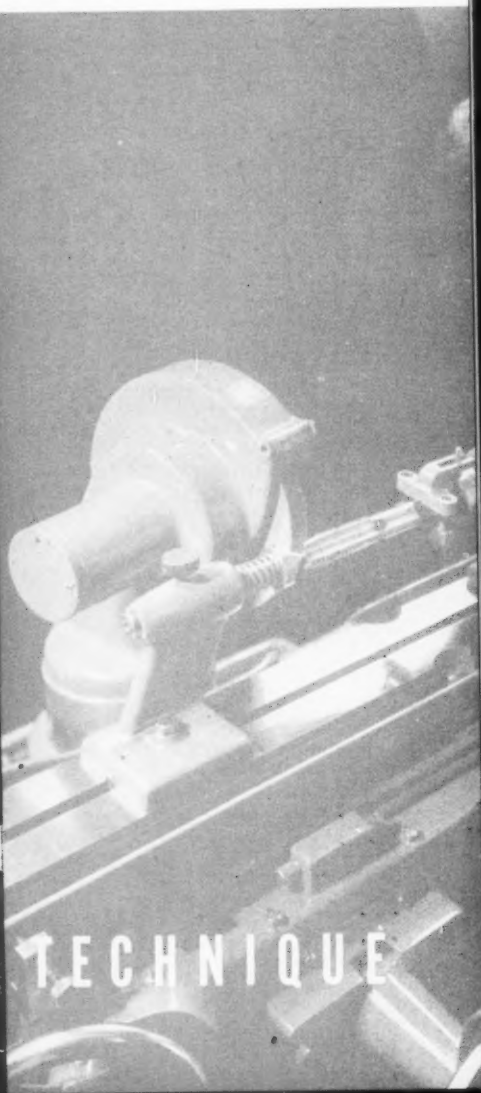
TRAINING *for Victory*

EDITORS: DON E. ROOT CHARLES H. HAYNES





THREADING TECHNIQUE

THREADING TECHNIQUE

To discuss all of the various types of threading now available to the tooling or production man would be impossible in this short supplement. One of the broadest threading operations, however, is tapping and the current backlogs with tap manufacturers make it particularly timely to devote this space to the technique for getting the longest possible use from taps and dies.

Tap and Thread Terms

That each of the technical names used in this article will be familiar, we have graphically illustrated them in Figure 1. A short summary of their definitions is as follows:

AXIS OF TAP: The longitudinal central line through the tap.

BODY: The threaded and fluted part of tap.

CHAMFER: The tapered outside diameter at the front end of the threaded section.

CUTTING FACE: The front part of the threaded section of the lands.

EXTERNAL (MALE) CENTER: Sometimes termed "male center." It is the cone shaped end of the tap. It is found only on small taps and is for manufacturing purposes.

FLUTE: The groove providing for the cutting faces of the threads or teeth, for chip passage and for lubrication.

HEEL: The back part of the threaded section of the land.

HOOK: The curved undercut of the cutting face of the land.

INTERNAL (FEMALE) CENTER: Sometimes termed "female center." It is the small drilled and countersunk hole at the ends of the tap.

LAND: The threaded web between the flutes.

POINT DIAMETER: The outside diameter at the front end of the chamfered portion.

RADIAL: The straight cutting face of a land which, if continued, would pass through the center of the tap.

RAKE: The angle of the cutting face of the land in relation to a straight line from the point of the cutting face to the axis.

SHANK: The part behind threaded and fluted section of tap.

SQUARE: The squared end of the tap shank.

THREAD: The cutting tooth of the tap which produces the thread.

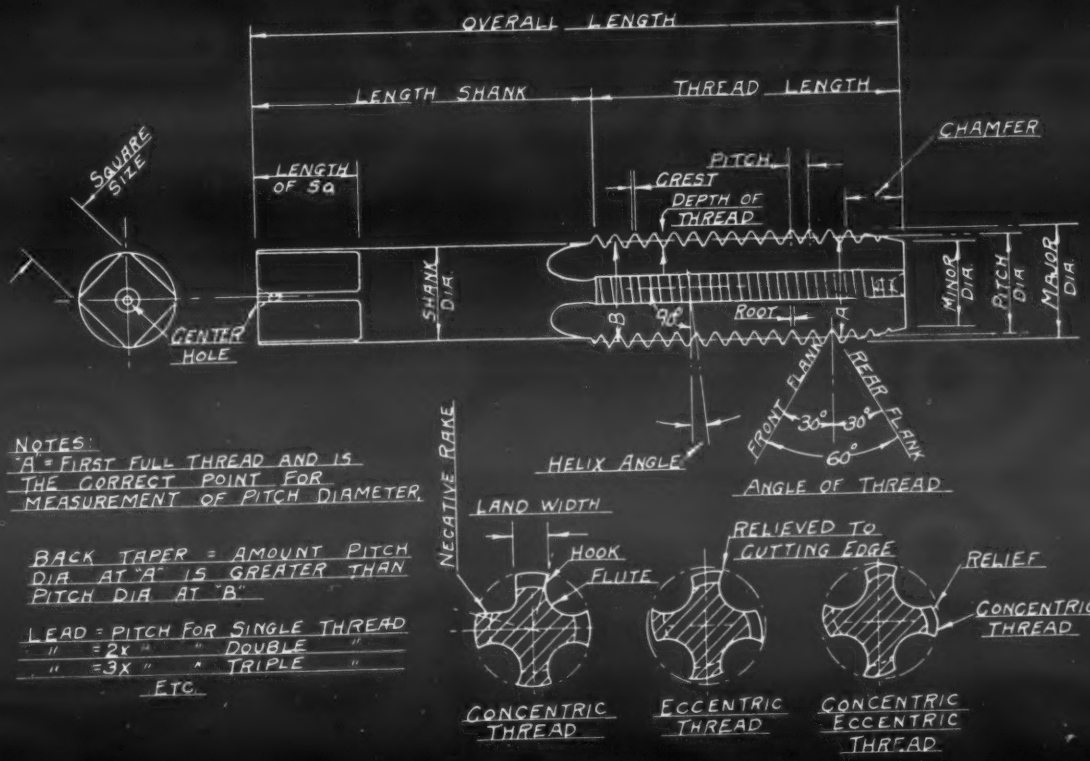
THREAD RELIEF (RADIAL): A clearance providing a gradual decline in the major pitch and minor diameters of the lands, back of the cutting face. This style of relief is applied only to certain sizes and types of taps.

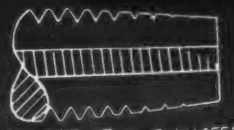
Types of Taps

Many different types of taps have been developed for numerous applications. The most widely used tap for production is the plug hand tap. As a rule these taps are furnished in sets of three—taper, plug and bottoming. All three are identical as to size and length, their only difference being in the chamfered threading portion at the point. The taper has the longest chamfer of the three, usually about ten threads. The plug tap usually has about five threads of chamfer and the bottoming tap only one. When tapping by hand in open or through holes the taper hand tap should be used for coarse pitch threads as it insures straighter starting. It is also recommended for the harder metals. The plug hand tap can be used in such holes when tapping soft metals of fine pitch threads. In a case of closed or blind holes when tapped by hand to the bottom all three taps should be used. Serial hand taps are similar in general dimensions to the taper, plug and bottoming taps, but differ in that each tap cuts only a certain percentage of the thread. Usually there are three taps to a set, numbered respectively, 1, 2 and 3.

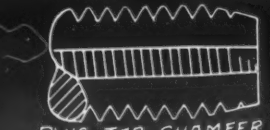
Machine screw taps are really small size hand taps except they are designated by numbers zero to thirty instead of fractional sizes. Gun taps are strictly a production tool and are very desirable

TAP AND THREAD TERMS

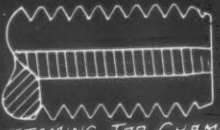




TAPER TAP CHAMFER
8 TO 10 THREADS



PLUG TAP CHAMFER
3 TO 5 THREADS



BOTTOMING TAP CHAMFER
1½ THREADS

NOTES:
"A" = FIRST FULL THREAD AND IS THE CORRECT POINT FOR MEASUREMENT OF PITCH DIAMETER

BACK TAPER = AMOUNT PITCH DIA AT "A" IS GREATER THAN PITCH DIA AT "B"

LEAD = PITCH FOR SINGLE THREAD
" = 2x " " DOUBLE "
" = 3x " " TRIPLE "
ETC.

when tapping stringy metals. These taps should not be used in closed holes because the flutes are so designed to throw the chips ahead of the tool. For open holes this feature is desirable since the chips do not collect and break in the flutes. Other taps used extensively include the following:

Taper Pipe Taps, Straight Pipe Taps, Taper Taps, Nut Taps, Pulley Taps, Staybolt Taps, Boiler Taps, Washout Taps and Acme Thread Taps.

With the exception of the last, all of these are designed to produce thread forms in conformance with the American National Design adopted by the National Screw Thread Commission. There are two standard series in commercial use, the NC (National Coarse), and NF (National Fine).

Ground Thread Taps

Mass production methods have necessitated definite tolerances for accuracy in assembly of threaded parts. To meet the various degrees of accuracy required, a standardized basis has been adopted. These working tolerances are known as loose fit, class 1; free fit, class 2; medium fit, class 3 and close fit, class 4. A common error in threaded assembly is lead error in the tapped part. This results in a weak assembly. Lead error has been partially overcome by scientific heat treatment; however, a ground thread tap can completely eliminate such errors. The ground taps are divided into commercial ground and precision ground. Commercial ground are held to a pitch diameter tolerance ranging from .001 to .002 with a lead tolerance of plus or minus .0005". Precision ground are similar except they are held to closer pitch diameter tolerances, generally .0005".

Type of Machine

The type of machine available, its mechanical condition, its adaptability, all have a marked influence on successful tapping operations. As an example, the choice as between carbon or high speed steel taps is more or less dependent upon the machine's speed capabilities.

The following are some of the points to consider.

1. Is the weight and size of the machine in proportion to the work and size of tap required, i e., not too light or too heavy? Generally, for light tapping operations, a small fast machine is recommended, while for large work a heavier machine will be found more successful.
2. If the machine is to be used for a variety of sizes, does it have sufficient speed changes to properly take care of the different sizes in order that the taps may be operated at their recommended speeds?
3. Is the machine properly powered to insure uninterrupted power transmission during the tapping operation?
4. Is the spindle in good condition and alignment, free to traverse without undue effort, yet fitted closely enough to exclude all vibration?
5. Is the work table true (when tapping vertically) and at right angles to the spindle within a comparatively close tolerance?
6. Are the ways (when tapping on a screw machine or turret lathe) in good condition and well lubricated to eliminate excess load or drag? Are the turret bed gibs sufficiently tight to prevent side motion and do the turret holes line up with the spindle?
7. Is the reverse mechanism sufficiently sensitive to give instantaneous action?
8. Are all belts sufficiently tight and free from oil to insure proper and continuous transmission of power?
9. In the case of a hand machine, is the feed handle of proper length for convenient manipulation? Excessive length tends to place additional leverage on the tap, which does not speed up production, but tends to cause excessive lead error and often loading of the tap. Breakage is not uncommon where too much leverage is applied.
10. Is the spindle of the machine properly counterbalanced? Added accessories such as chuck, friction

mechanism, and tapping attachment increase the weight of the spindle. While the difference in spindle weight may not be sufficient to cause bad threads, a slight excess weight on the spindle may cause taps to cut oversize due to burnishing of one flank of the thread while backing out, and this too may result in loading of the tap in soft stringy metal, particularly low carbon steel and brass. Therefore, if taps cut oversize for no apparent reason, and show a tendency to load when used on a machine where tapping attachments or heavy chucks have been added, it is well to check the balance of the spindle.

The "type of machine" to select for a specific tapping job, therefore, is a matter of selecting the one with the equipment best fitted for the work, and keeping it in adjustment and repair so that its influence on the job will be only that of rotating the tap. However, for through hole tapping, a vertical type of machine would be preferable in many cases as it facilitates easier chip disposal than some types of horizontal machines not especially designed for tapping.

Tap Holding Devices

Much has been accomplished in recent years in developing tap holding devices or chucks. Manufacturers of such devices have studied and analyzed the requirements, and have designed chucks with "better tapped holes" as their ultimate goal.

One of the features of these attachments is that their reversal speed is usually about double the forward speed, resulting in greater production. In addition they have a very sensitive clutch mechanism which stops the rotation of the tap immediately when it meets with interference—this reduces tap breakage. A feature incorporated in some attachments, which prolongs the life of the tap chamfer, permits the tap to idle in the forward motion and not in the reverse. Consequently, the tap starts to cut immediately upon entering the hole, avoiding damage to the cutting edge of the tap's chamfer which may happen where the tap idles in reverse and hits the work in the reverse motion.

Attachments for increasing the tapping speed on slow speed machines are also available. These have a gearing arrangement which gives the chuck holding the tap a higher speed than that of the spindle in the machine.

Frequently special holders are made to suit some particular requirement. Preferably such designs should provide for the application of standard stock taps. Special taps are considerably more expensive than standard taps, and, in addition, there is usually a delay in procuring such tools, as they must be made up special. Sometimes, however, regular stock taps can be altered by reducing the shank to fit some particular holder, and, while there is nothing wrong with such a procedure, it is important that

Fig. 2

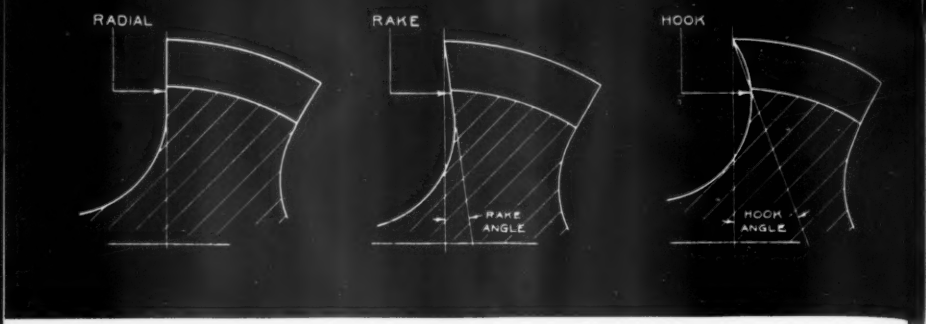


Fig. 3

the reduction, which is accomplished by grinding, be handled mechanically. The grinding operation, in other words, should be handled the same as any other cylindrical grinding job, between centers, to insure concentricity between the shank and threaded section. Grinding should not be attempted by hand, as it cannot be done accurately. If a tap is held by a shank that is excessively out of round, tap breakage, short life and poor tapped holes are bound to result.

Physical Composition

CHEMICAL COMPOSITION: Without going into technical details, it is probably sufficient to say that carbon steels, as a rule, contain only carbon, iron, and small percentages of other elements added for a definite purpose in manufacturing, but in such small amounts that they are not considered as alloying elements. The total of elements other than carbon and iron in a straight carbon tool steel seldom exceeds one percent in weight while in a high speed steel the alloy content may be as high as 30 percent.

These elements in high speed steel consist principally of tungsten, chromium, vanadium, manganese, molybdenum, and sometimes cobalt. Added in proper proportions, these alloys produce a more stable condition in the steel with ability to resist heat, and abrasion.

HARDNESS: The property of "red-hardness" in high speed steels is the ability of that steel to retain its hardness even though the tool is heated in use up to a dull red. Straight carbon steels do not have this property.

TOUGHNESS: Generally speaking toughness is a measure of the resistance of the steel to torsional (twisting) stresses or to impact (sudden blow) stresses or to a combination of both. While there is still much to be learned about such stresses and their measurement, it may be stated briefly that results of various methods point to carbon steels as being somewhat tougher than high speed steels, assuming that both have been properly heat treated.

WEAR OR ABRASION RESISTANCE: While there are no standardized methods for the determination of this factor, investigation has shown that high speed steels, as well as other steels of similar structure, are definitely superior to carbon steels even for applications where cutting ability is disregarded. Typical of these applications are bending mandrels, broaching punches, blanking dies, and forming rolls.

THERMAL OR HEAT CONDUCTIVITY: The thermal conductivity of elements or alloys is a well-defined mathematical quality which is a measure of the ability of that element or alloy to transmit heat. It can be readily seen how this property would affect the cutting efficiency of a tool. Even though the tool might be operating under a flood of oil or other coolant, the cutting edges are being heated rapidly by friction of the tool against the material being cut, so, unless this heat is carried away quickly, heating of the tool becomes progressive and the cutting edges become dull.

With carbon tool steels, the thermal conductivity remains constant or decreases as the temperature of the cutting edge approaches the temperature at which the tool was tempered. That is,

if a carbon tool was originally tempered by the manufacturer at a temperature of 430° F, for example, then as the tool is put into service and the friction of cutting heats the tool up to that temperature, the thermal conductivity of the carbon tool remains constant or decreases. As the tool is heated still further the thermal conductivity decreases rapidly, and, because of the inability of the tool to carry the heat away, further tempering of the tool takes place resulting in soft cutting edges.

In the case of the high speed steel, however, as the heat developed by friction raises the temperature of the cutting edges, no change in thermal conductivity or hardness takes place until the original tempering temperature (1050° F-1120° F) has been reached and then the thermal conductivity increases and the cutting edges carry away the heat rapidly enough to prevent breakdown.

Of course, there is a limit to the safe operating temperatures for high speed steel and when this limit is exceeded, a high speed tool will fail also. However, the fact that a high speed steel tool may be operated safely at 600° or 700° F hotter than a carbon tool, is the simple explanation of why high speed tools should be operated at speeds high enough to produce a moderate rise in temperature.

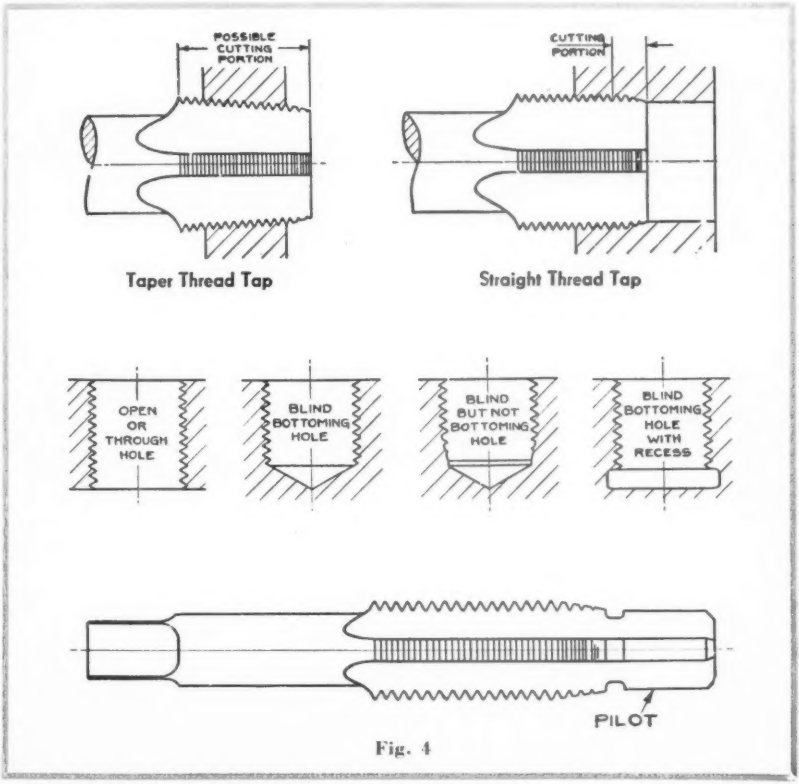


Fig. 4

Nature of Materials To Be Tapped

The material used in parts to be tapped is a very important factor entering into proper tap selection for mechanical tapping. Frequently, the user of taps does not realize what a decisive influence a certain material has on the tap. A few examples will show the importance of this factor. First, consider one of the most widely used of metals—cast iron. This metal has a very abrasive action on taps. Therefore, high speed steel taps should be used because of their superior ability to resist abrasion.

When tapping in brass, consideration should be given to speed because brass machines freely; taps can be operated at high speeds. If the speed available is sufficiently high to employ high speed steel taps at their recommended speeds, then they should be used, otherwise carbon steel taps are suggested.

In the case of copper either carbon or high speed steel taps can be used, the selection again being entirely dependent upon available speeds.

Steels present a still different condition — the majority of these can be tapped only with high speed steel taps except machinery and certain types of tool steels which can be tapped with carbon steel taps.

The shape and angle of the cutting face of a tap in many cases influence its performance in certain materials, and since no tap can be made to work successfully on production in every material, it is desirable sometimes to alter its cutting face design or angle.

There are three types of cutting faces usually incorporated in tap designs, namely — radial face, raked face and hooked face. These three designs are shown in Fig. 3.

Stock taps are provided with a flute and cutting face design which experience has proven to be best adapted for the majority of tapping requirements including both metallic and non-metallic types. Some of these are listed below:

Machinery Steel	Malleable Iron
Cold Rolled Steel	Pipe Fittings (Cast
Brass*	Iron, Malleable
Cast Iron	Iron, or Brass)
Bronze*	Celluloid
Bakelite	Fiber
Beetleware	Pyroxylin

Cutting faces of taps for cast iron, malleable iron and brass are usually radial; however, a rake of 3°-5° is sometimes desirable.

Such materials as cast steel, manganese steel, molybdenum steel, vanadium steel or steel pipe fittings will invariably tap better when the cutting face of the tap has up to a 10°-15° rake. Cast aluminum, die cast metal (lead, zinc or aluminum), Duralumin, Herculoy, molychrome steel, nickel-chrome steel, Allegheny metal, monel metal, Ambrac (70% copper), rolled aluminum, rubber (hard) and certain stainless steels tap better with a hook up to 10°-15°, whereas babbitt, bronze (aluminum), copper, Duronze (copper) and nickel silver can be tapped better with a tap having up to a 20° hook.

The size of the tap must also be considered as it has been found by experience that in a given material, hook or rake angles of the cutting faces must be varied according to the size, depending upon the strength of the lands.

When special taps are ordered for use in any of the materials requiring a 10 to 15° rake or up to a 20° hooked cutting face, such designs are incorporated in the milling operation of the flute by means of special cutters. However, if a stock tap is altered to one of the latter designs the change is best accomplished by grinding.

Preparation of Holes for Tapping

Because the tapping operation follows the drilling operation, there is a tendency on the part of some drillers to overlook the importance of properly drilled holes on the subsequent tapping operation. Yet for the tapping of high

*When tapping these materials, it is also desirable to narrow the lands of the tap approximately as follows:

3 land tap—land width = 1/5 of tap diameter
4 land tap—land width = 1/6 of tap diameter
5 land tap—land width = 1/7 of tap diameter
6 land tap—land width = 1/9 of tap diameter
8 land tap—land width = 1/12 of tap diameter

Quite frequently, taps of special design are provided with pilots, preceeding the threaded section, for the purpose of maintaining alignment.

quality threads, particularly at production speeds, properly drilled holes are of vital importance, and it should be borne in mind that the tap is not a corrective for poorly drilled holes.

Generally considered, there are two types of holes—open or through, and blind or bottoming. Depending upon the type of material, the class of fit, and the method of tapping, the following styles of hand taps are used for open or through hole tapping when this type of tap is adaptable. In steel and other types of malleable material, tapped by machine, the gun and plug tap are most commonly used. For cast iron and nonmalleables, the plug tap produces best results. Some holes may be considered blind and yet not bottoming, for the reason that it may be possible to drill the hole considerably deeper than it is necessary to tap. In such cases it is possible to proceed as for through holes, using the same style of tap as would be used if the hole were really a through one. However, if the thread must extend to the very bottom of the hole, a bottoming tap should be used.

In all cases and in all types of holes, good clean drilling and a reasonable degree of size maintenance will add considerably to the ease of tapping good threads, and will lessen the strain on the tap.

Quite frequently, taps of special design are provided with pilots, preceding the threaded section, for the purpose of maintaining alignment.

Controlling the size of drilled holes for such taps is most important because holes looser than a free fit for the pilot size defeat the purpose of the pilot, while tight holes add unnecessary, if not excessive, load to the tap. "Go" and "not

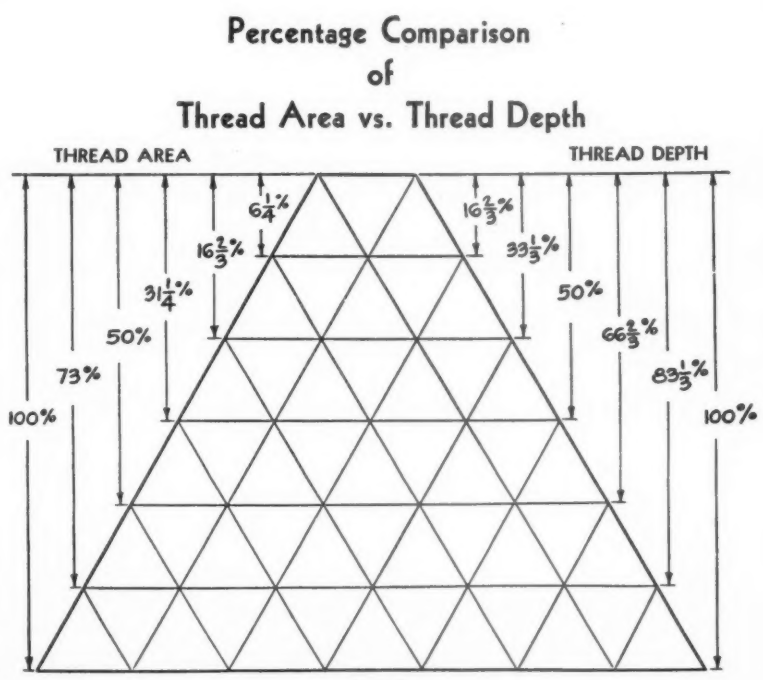


Fig. 5

go" plain plug gages for controlling the size of drilled holes are a good investment.

Of equal importance when tapping to the bottom of a hole is the matter of clearing out the drill chips, or other accumulated material before starting to tap. Tap breakage frequently results from the impact of the tap upon a bed of drill chips at the bottom of the hole.

Another type of hole that frequently presents difficulties in tapping is the one prepared for tapered threads. When tapping with a tapered thread tap such as a taper pipe tap, it should be borne in mind that every tooth of the tap in the hole is cutting, whereas with a straight thread tap only the chamfered portion and the first full thread does the cutting, the remainder of the straight threads acting only as a guide or follower.

Naturally, the tapered thread tap carries a much greater load which increases as the tap advances. To lighten this load, the hole should be bored or reamed taper before tapping.

It is generally understood today that the size of a drilled hole, prior to tapping, should be large enough to produce a thread depth of approximately 75%. Lower power consumption and less tap-

TABLE I

Suggested Tapping Lubricants

Material Being Tapped	Lubricant
Allegheny Metal	Sulphur Base Oil
Aluminum	Kerosene & Lard Oil
Bakelite	Dry
Brass	Compound or Light Base Oil
Bronze	Compound or Light Base Oil
Bronze—Manganese	Light Base Oil
Copper	Light Base Oil
Die Castings—Aluminum	Kerosene & Lard Oil
—Zinc	Compound
Duralumin	Compound or Kerosene & Lard Oil
Fiber	Dry
Iron—Cast	Dry or Compound
—Malleable	Compound or Sulphur Base Oil
Monel Metal	Sul. Base Oil or Kerosene & Lard Oil
Nickel Silver	Sul. Base Oil or Kerosene & Lard Oil
Rubber (Hard)	Dry
Steel—Cast	Sulphur Base Oil
Steel—Chromium	Sulphur Base Oil
Steel—Machinery	Compound or Sul. Base Oil or Kerosene & Paraffin
Steel—Manganese	Compound or Sul. Base Oil or Kerosene & Paraffin
Steel—Molybdenum	Sulphur Base Oil
Steel—Nickel	Sulphur Base Oil
Steel—Tool	Sulphur Base Oil or Kerosene & Lard Oil
Steel—Tungsten	Sulphur Base Oil
Steel—Vanadium	Sulphur Base Oil

ping troubles are the two major reasons which prompted adoption of the 75% thread depth because it has been proven that in tapping a full 100% thread depth, about three times more power is necessary than when tapping a 75% thread, yet the former is only about 5% stronger. The tap user must determine for himself what is best for his particular requirements, but, by analyzing the following subjects, the problem can be very easily solved.

1. Diameter and pitch of tapped hole
2. Nature of material being tapped
3. Depth of the tapped hole

As to the first consideration, diameter and pitch of tapped hole, consider whether the tap required has a fine or coarse pitch in relation to its size, bearing in mind that the coarser the pitch the smaller the thread depth should be. It is suggested (assuming the design of the tap is correct for the requirement at hand) that the 75% thread depth be tried first, and, if this results in tap breakage, the thread depth should be reduced gradually until satisfactory conditions are produced. In doing so, the question may arise as to whether such a reduction might possibly jeopardize the strength of the thread. This can also be

TABLE II

Suggested Tapping Speeds

Material Being Tapped	Speed in Feet per Minute		
	Carbon Taps	Regular High Speed Taps	"Maxi" High Speed Taps
Allegheny Metal	*	15–25	20–30
Aluminum	45–50	90–100	100–110
Bakelite	*	60–70	70–80
Brass	45–50	90–100	100–110
Bronze	20–30	40–60	50–70
Bronze—Manganese	*	30–45	35–50
Copper	45–50	90–100	100–110
Die Castings	30–35	60–70	70–80
Duralumin	45–50	90–100	100–110
Fiber	*	80–90	90–100
Iron—Cast	*	70–80	80–90
Iron—Malleable	*	35–60	45–70
Monel Metal	*	20–25	25–30
Nickel Silver	*	75–85	85–95
Rubber (Hard)	*	80–90	90–100
Steel — Cast	*	20–30	25–35
Steel — Chromium	*	20–30	25–35
Steel — Machinery	20–30	40–60	50–70
Steel — Manganese	*	10–15	15–20
Steel — Molybdenum	*	20–30	25–35
Steel — Nickel	*	25–35	30–40
Steel — Stainless	*	15–25	20–30
Steel — Tool	15–20	25–35	30–40
Steel — Tungsten	*	20–30	25–35
Steel — Vanadium	*	25–35	30–40

*Carbon steel taps are not recommended for these materials.

Fig. 6

readily determined for we know that a nut with only 50% thread depth, made to standard specifications, will break the bolt before it will strip the threads.

It is well to consider some of the basic peculiarities that exist in our threading system so that we may better understand why tapping problems arise from this source. For example, the table above, covering a group of tap sizes in the National Coarse and National Fine Thread Series, shows what percentage the double thread depth is in relation to the basic major diameter, and plainly

Fig. 7

reveals that the smaller the tap the greater the thread depth proportion.

Basic Major Diameter	N.C.	N.F.
1"	16%	9%
¾"	17%	11%
½"	20%	13%
⅜"	22%	14%
¼"	26%	19%
No. 5 Machine Screw	32%	26%

After fluting suitably for this thread depth, weakness develops rapidly as the taps grow smaller; therefore more care should be exercised when using small taps.

Another interesting fact, illustrated by the chart in Fig. 5, is that, as the thread depth decreases, a still greater decrease is effected in the thread area. An 83⅓% thread depth for instance represents only a 73% area, a 66⅔% thread depth means only a 50% thread area, etc., consequently, a decrease in thread depth effects a still greater drop in the amount of material the teeth of the tap must remove which in the case of using coarse pitch taps is a very favorable condition.

As to the nature of material being tapped, we should bear in mind that soft stringy metals such as copper, drawn aluminum, monelmetal, nickel and silver, due to their malleable nature have a tendency to flow towards the crest of the minor diameter while being tapped; therefore, the minor diameter of tapped holes in these materials will be smaller after the tapping operation, and this condition should be taken into consideration when deciding upon the tap drill sizes.

The toughness and hardness of the material should also be considered. Some of the alloy steels and metals that are very tough or of a high hardness can be tapped more successfully with less than 75% of thread and where these characteristics exist the smallest thread depth possible should be adopted.

The depth of tapped hole is also very important. When tapping holes to a depth of more than one and one half times the diameter of the tap, especially when using machine screw sizes, it will be found advantageous to use larger drills than the 75% type. Drills which will give a 50% thread will be found entirely satisfactory.

Certain punched holes in thin sheet

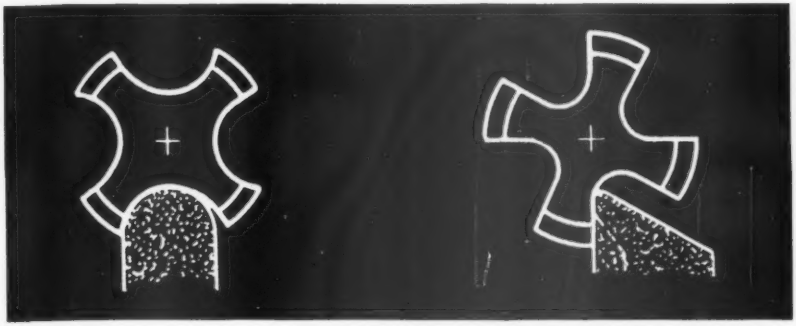
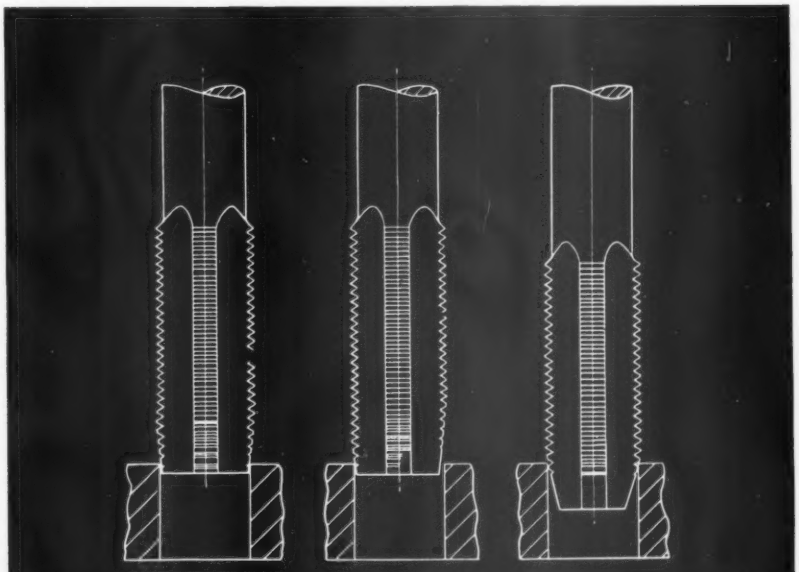
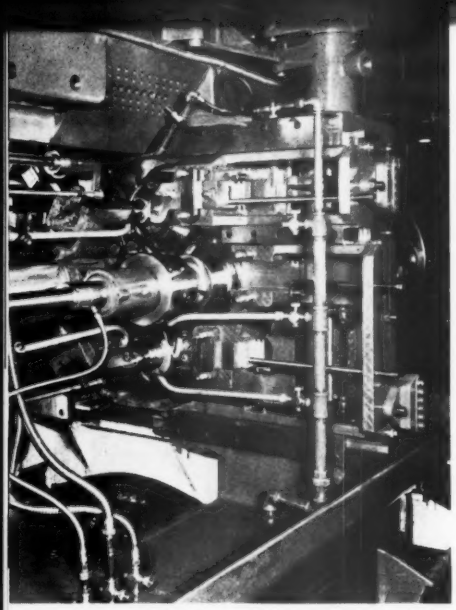


Fig. 8—Grinding Radial and Hook Angles.

Fig. 9—Correct Chamfer Resharpening.


Chamfer correctly ground. All lands of chamfered portion in contact. Point diameter large enough to permit only one thread to enter, thus getting full cutting benefit of practically entire chamfer.
Chamfer incorrectly ground. Lands of chamfered portion are uneven as to height, thus forcing entire cutting burden on lesser number of lands. Result — poor threads, increased power consumption, and high tap breakage.
Chamfer correctly ground as to height of lands, but point diameter too small forcing entire cutting burden on small portion of chamfered section. Result — greater power consumption, and shorter tap life due to dulling of cutting edges.



metal often create occasional tapping difficulties such as loading, thus causing tap breakage.

Importance of Proper Lubrication in Tapping

Longer tap life, greater production, better size control, smoother and more accurate threads, less resharpening, also more efficient removal of chips are some of the direct results traceable to the application of proper lubricants or what are also termed cutting fluids. Many tap users do not appreciate the important part that proper lubricants play in tapping operations. There is no one lubricant or oil that can be applied to efficient and economical tapping of all requirements.

Table I gives suggestions that will serve as a preliminary guide.

In addition to using the proper lubricant, some thought should be given to its method of application. To insure the utmost effectiveness it is desirable to force the lubricant into the hole under pressure. The amount of pressure applied naturally is variable and dependent upon the method of tapping, hole depth and tapping speed. However, in horizontal tapping, where the tap is stationary and the work revolves it is desirable to use two streams of lubricant, one on each side of the tap. The lubricant should enter the hole parallel to the axis of the tap where conditions permit such an arrangement. Where they do not, then at the smallest permissible angle. This will prevent the tap from running dry, and will facilitate chip removal.

Tapping Speeds

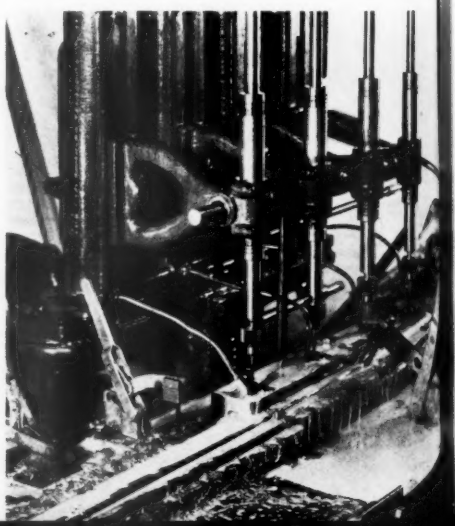
Proper speeds are essential for successful tapping. There are certain speeds at which taps operate efficiently in specific materials, but the composition of the material to be threaded, the kind of steel from which the tap is made, and the design of both the tap and tapping machine, all have a direct bearing on the tapping speeds.

The importance of proper tapping speeds cannot be stressed too strongly, for too much or insufficient speed are both detrimental to efficient tapping. A little experimentation will soon determine the right speed at which to operate. High or maximum speeds should only be reached by gradual stages of experimentation.

A table of suggested tapping speeds for the most commonly used taps and materials is shown in Table II but due to the many variables that enter into tapping this table should only be used as a guide for determining speeds at which taps will operate efficiently.

Resharpening and Grinding Taps

Taps like all other cutting tools be-



come dull through constant use. When dull they are liable to chip, break, produce rough and poor threads, or cut oversize. Furthermore, taps that are dull cut much harder and require more power to drive. They also frequently slow down the tapping machine. This condition can be easily remedied by resharpening. As a rule the chamfered portion or point is the only part of the tap that requires sharpening.

The sketches in Fig. 9 show the results of both correct and incorrect chamfer grinding.

The ideal way is to resharpen taps on a regular tap grinding machine. There are several such machines available, which reproduce the original grind accurately. This results in easier cutting, more accurate tapping and longer tap life.

Where a tap grinding machine is not available, and the tap must be resharpened by hand, great care should be exercised, so as to reproduce as nearly as possible the original grind of the tap manufacturer. To get best results a new tap should be used for comparison, and the operator should note carefully the number of threads chamfered, the angle, and depth of eccentric relief back of the cutting edges. A soft 80-grain grinding wheel should be used for this purpose.

The tap may also require grinding in the flutes occasionally to touch up the cutting edges of the threads or teeth. A simple method for this form of grinding is to mount the tap between centers upon a universal grinder and pass the tap back and forth under the grinding wheel. To prevent the tap from turning, the back face of the land can be held against the blade of a universal tooth rest. A hard 60-grain grinding wheel should be used and the wheel should be of the saucer or dish type when the cutting face to be ground is radial or has a straight rake. However, when the cutting face is hooked, a straight disc grinding wheel should be used and its periphery formed to suit the type of hook necessary. Forming or dressing the grinding wheel can be accomplished more accurately with a diamond, taking no deeper cuts than .001" to .002" per pass of the diamond.

Regardless of whether a tap is ground by hand or in a machine, only light grinding cuts should be taken to prevent the burning of the cutting edges. Polishing the ground portion after grinding is also advisable when tapping materials that have a tendency to load. Broken teeth or threads in the tap should always be completely removed, otherwise they will damage the threads in the tapped hole. The complete elimination of broken teeth will usually have very little effect on the efficiency of the tap.

There are certain taps that should always be machine ground and mechanically indexed, namely, taps relieved in the threads up to the cutting face. Such taps are Taper Pipe Taps and Special Taper Thread Taps. Machine grinding and correct indexing insure accurate spacing of the cutting faces, also uniform heights of the various lands from the axis to the tap. This type of grinding eliminates the possibility of tapping out of round holes.

Trouble Sources in Tapping

The various steps incidental to good tapping have already been considered, and, as a guide for locating the source of tapping troubles which may be encountered, we suggest checking the points listed below.

Type of Machine
- Was tap started correctly?
- Is drive uneven because of slipping belts?
- Is machine powered properly?
- Are tap and drilled hole in alignment?
- Is there undue wear on sliding parts?

Tap Holding Device
- Is worn or wrong type of holder being used?
- Is holder in alignment with drilled hole?

Type of Holes to be Tapped
- If a blind hole, is there sufficient untapped space at the bottom for the accumulation of chips?
- Is a "Gun" tap that shoots the chips ahead being used? (In a blind hole tapped very nearly to the bottom and having no recess, the "Gun" tap is not recom-

mended.)
Does condition call for a two or three fluted tap?
Classes of Fit Required
If the tap produced an oversize hole, has the proper tap been selected for the class of fit desired?
If proper tap is being used, is there any play in the work or tap holding spindles?
Do the work and tap line up accurately?
Is the tap dull?
Tapping Different Materials
Has the tap the proper cutting face for the particular material being tapped?
Is the tap of the proper design or type?
Proper Hole Sizes before Tapping
Is the drilled hole of the proper size?
Is the drilled hole perfectly round?
Is the axis of the hole parallel to the axis of the tap?
Lubrication
Has the proper lubricant been employed?
Does the lubricant flood the tap sufficiently while engaged in the hole?
Is there sufficient force behind the lubricant to wash away the chips?
If applied with a brush has the lubricant a sufficiently heavy body to adhere to the tap? (A light lubricant will be thrown off the revolving tap before it enters the hole.)
Tapping Speeds
Is the speed too slow?
Is the speed too fast?
Chamfer (Resharpening and Grinding)
Is the point diameter correct for the size of the hole being tapped? Or does the tap enter the hole for a distance of several threads before taking hold, thereby losing the full benefit of the entire chamfered portion?
Is the chamfer the correct length?
Is the chamfer chipped or dull and in need of regrinding?
Is the chamfer relief too great or not sufficient.

We are indebted to the following firms who provided illustrations and textual data: Greenfield Tap & Die Corp.; Winter Bros. Div., National Twist Drill Co.; Procunier Safety Chuck Mfg. Co.; Douglas Machy. Co.; and Delta Mfg. Co.

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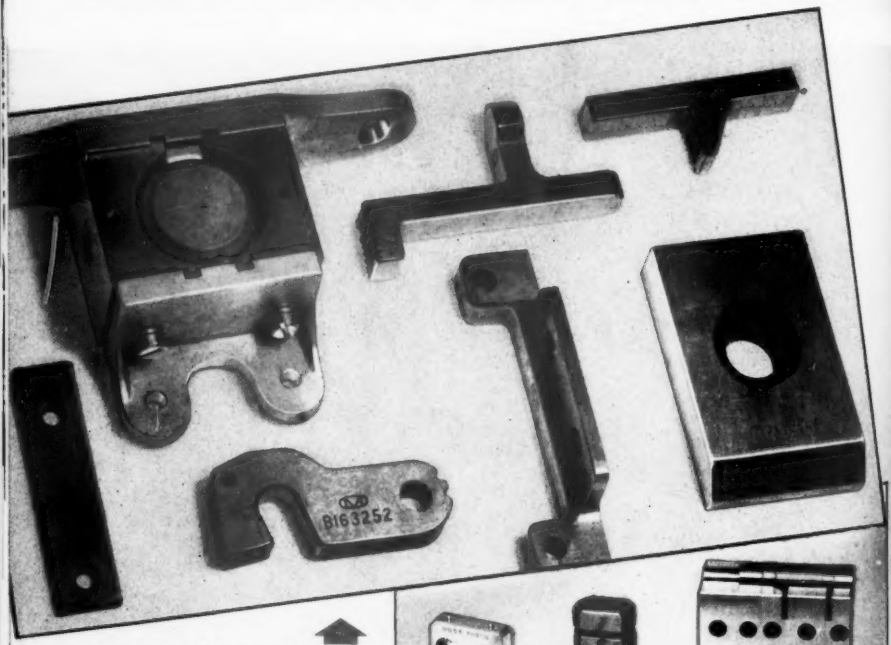

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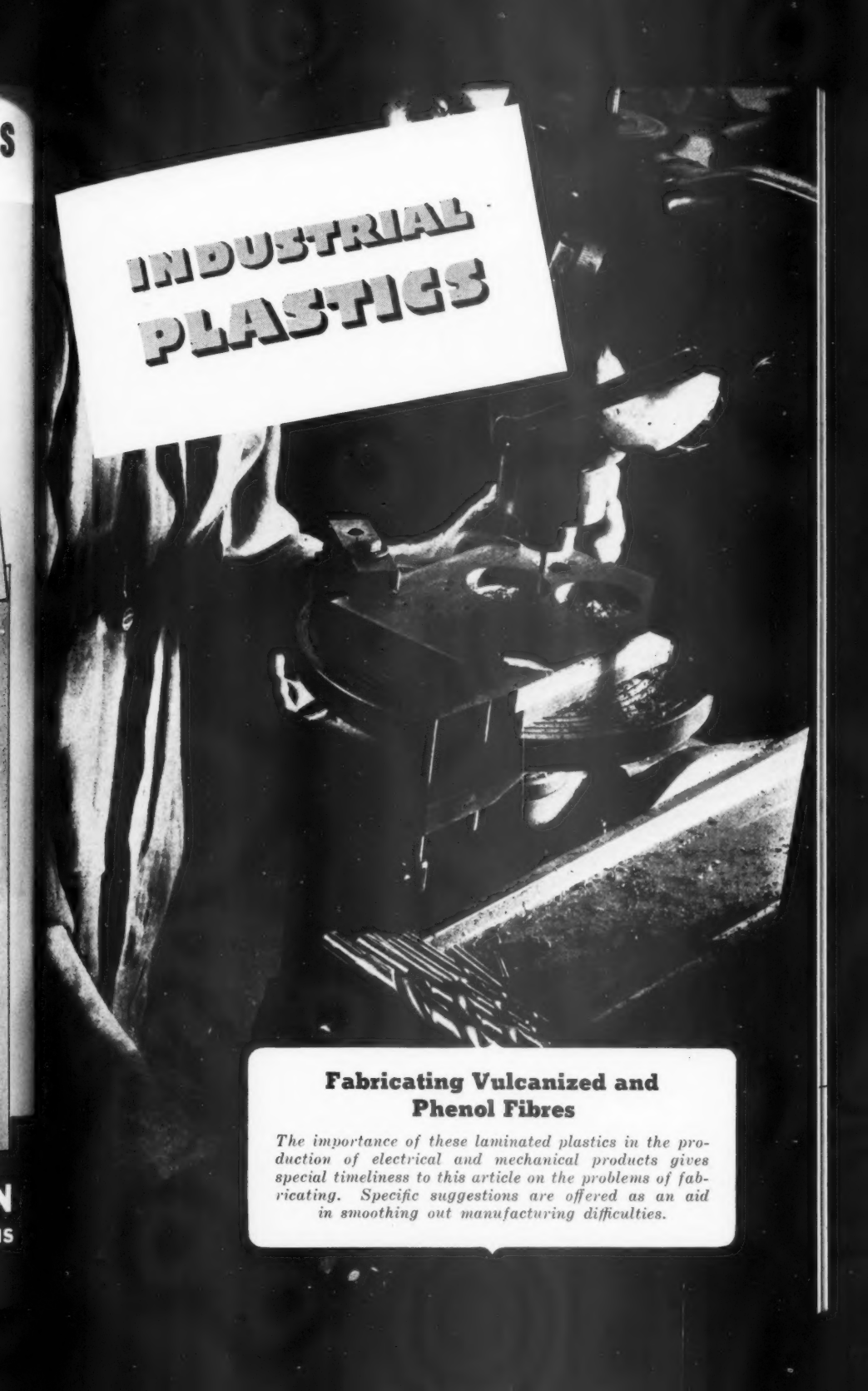

Fabricating Vulcanized and Phenol Fibres

The importance of these laminated plastics in the production of electrical and mechanical products gives special timeliness to this article on the problems of fabricating. Specific suggestions are offered as an aid in smoothing out manufacturing difficulties.

FABRICATING VULCANIZED FIBRE AND PHENOL FIBRE*

VULCANIZED fibre has come into such general use today that scarcely a product of electrical or mechanical nature does not have at least one or more uses for this versatile material. Laminated phenol fibre, with its unusual combination of insulating and mechanical properties, has a broad field of applications to which other products are not adaptable. The fabricating of these two war-essential materials presents many problems to the manufacturer. The following suggestions are offered to help in the solution of those problems.

Smooth Sawing

Vulcanized fibre and phenol fibre can be sawed to a smooth edge with hollow ground circular saws. These saws should be 14" in diameter with 110 to 120 teeth, and from ⅛" to $\frac{3}{32}$" thick at the outer edge. If this special type saw is not available, any good grade of metal cutting saw will give satisfactory results. The saw should travel at the speed of 2500 to 3600 rpm.

The saw teeth should be square, sharp and free from burrs and wire edges. The proper tooth angle is as follows: A straight edge placed on the side of the saw in line with the cutting face of the saw tooth should pass directly through or slightly back of the arbor hole. The rim of the saw should be concentric with the center hole. The temper of the saw should permit sharpening by filing.

Band Sawing

Band saws with 5½ points per inch and 19 gauge thickness are used for best results. Widths vary from ¼" for scroll work to 1¼" for heavy sheet sawing. The saw should run from 400 to 5000 feet per minute. Band saws should be tempered to permit filing and should be reset at least every day when in constant use.

Punching

Vulcanized fibre and phenol fibre may be blanked, pierced and shaved on ordinary punch presses. Punches should be a close fit in the dies for best results. When punching stock $\frac{3}{32}$" thick and over it is best to use compound dies. In thicknesses above ⅛" or $\frac{3}{16}$" it is advisable to heat the stock to from 180° to 200° F before punching. Allowance should be made for hole shrinkage as follows: In material $\frac{1}{16}$" thick, holes will shrink approximately .004" in diameter; in $\frac{3}{32}$" thick material, approximately .006"; in ⅛" thick material, approximately .008" and in $\frac{3}{16}$" thick material, approximately .012". When stock is heated for punching, an allowance of .0025" should be made for shrinkage between holes.

Drilling

For the drilling of vulcanized fibre and phenol fibre, high speed drills and high speed drill presses are recommended. For ordinary drilling problems, special drills for this purpose are obtainable direct from the manufacturer. In many cases, however, additional clearance to the twist of the drill may be desirable. The twist should be cut back, allowing the cutting edge of the drill to remain as it is.

Because they are very dense, vulcan-

*The material in this article has been supplied by the Taylor Vulcanized Fibre Co., Norristown, Pa.

ized and phenol fibres produce a large quantity of chips which should be frequently removed from the hole during the drilling operation to prevent the drill from burning. The grinding of a long point on the drill assists in clearing the hole of chips. Sharp drills are essential if accurate holes are to be produced. Whenever possible drilling should be perpendicular to the grain or laminations. If it is necessary to drill parallel to the grain, the product should be supported during the operation by means of a clamping device. Drills should be fed slowly. Due to the resilience of the material, the hole often closes in slightly during the drilling. It is therefore well to try out the material before ordering jigs.

Milling

In milling with standard milling cutters, high speeds and feeds will give the best results both as to finish and length of time between grinds. Two-bladed fly cutters for form work should be run at higher speeds but slower feeds. Use a high speed and slow feed so that the cutter throws chips away from the work and keeps cutting, thus avoiding excessive rubbing action which heats and dulls the cutting tool quickly. For deep slots use side milling cutters as the material will bind if straight side cutters are used.

For planing, use a high speed and slow feed as in milling, taking a deep cut which should never be less than $\frac{1}{16}$".

Shearing

The shearing of vulcanized fibre and phenol fibre sheet stock is easily accomplished by means of a guillotine type shear. Regular steel shears may also be used, but to get satisfactory results, the upper shearing blade should be beveled to from 30° to 45°. Heating the material also provides easier shearing and will give better results, particularly when shearing narrow strips. Vulcanized fibre and various grades of paper base phenol fibre may be sheared cold in moderate thicknesses. As the thickness increases, the application of heat to the stock is usually found necessary.

The fabric base grades of phenol fibre may be easily sheared. The canvas and linen grades can be sheared cold in thicknesses up to $\frac{1}{16}$", and with the application of heat, can be satisfactorily sheared in thicknesses up to $\frac{1}{8}$".

Turning

Vulcanized fibre and phenol fibre require sharp tools with plenty of clearance. These materials are extremely hard and tough and for this reason it is desirable to keep the cutting edges in good condition. Also, since they are slightly elastic, they are inclined to impinge against the back of the tool, thereby generating heat with a consequent dulling of the cutting edge. As a general rule the tools should be ground about the same as for cutting brass. The fibre should be turned at the same peripheral speed as for brass. No lubricant is needed on the tool.

Reaming

It is difficult to ream vulcanized fibre and phenol fibre with ordinary tools since two or three holes will dull the reamer and holes will not be to size. Fair results can be obtained with an expansion reamer using slow speed and fast feed. Better results can be had by using a floating reamer which centers itself with the work.

Tapping

Vulcanized fibre and phenol fibre may be satisfactorily tapped. In tapping paper base phenol fibre, it is desirable to use a drill which is about .004" *oversize* on the basis of any standard tap. This prevents the tap from breaking and provides a very good thread.

Stamping

Vulcanized fibre may be stamped in the same manner as other materials. When phenol fibre is desired for stamping it should be so specified. Good stamping stock should not have a high gloss finish. Stock to be stamped should be of uniform thickness within .005" total thickness variance. The stock should be slightly warmed.

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PRACTICAL POINTS
IN MOLD DESIGN AND CONSTRUCTION

These continue the series of practical points in Plastics mold design and construction which began in March. They should prove equally helpful to designers, builders and users of Plastics molds and molding equipment. Handy reprints are available without cost. Address— Industrial Plastics, 2460 Fairmount Blvd., Cleveland, O.

77. Make sure the mold is properly set in the press before starting to run it.
78. Make sure the proper molding materials and inserts, if any, are being used, and that gages are at hand.
79. Find out the proper procedure for running the job.
80. Have the first pieces checked by the inspector, and then rechecked as often as necessary.
81. Keep the molding material clean. Dust or dirt may spoil a molding and small pieces of metal may damage the mold or other molding equipment.
82. Keep the molding material containers off the floors as the floors may be flooded from time to time, and then the material may be damaged due to the moisture absorbed.
83. When molding material is stored in a cold room, dry it before using to remove any condensed water which may collect due to moving the material into a work room of higher humidity.
84. Return unused molding material and inserts to the stock department at the end of a run.
85. Keep scrap thermoplastics material clean. It can be ground and reused. Do not save overheated scrap as it may have suffered damage due to breakdown, loss of plasticizer, or color deterioration.
86. Do not put scrap moldings which have metal inserts in them in the same container with sprue scrap from thermoplastics materials Keep the moldings separate so the metal can be removed before the material goes to the grinder. Brass inserts require especially careful attention because the brass will not be picked out by a magnetic separator. The scrap grinder may grind small inserts without seriously damaging the grinder but the chips usually will plug the injection molding machine nozzle.
87. Do not put scrap thermosetting material in the waste barrel if the moldings have metal inserts. The inserts can be salvaged.
88. Before beginning another cycle, be sure the mold is cleaned after removing the molded piece.
89. Do not use steel picks, bars, rods and the like to remove or pry out stuck moldings from a mold. Use brass or wood and very carefully.
90. Watch the mold to detect bent or broken core pins or burrs which may cause defective moldings to be produced.
91. Avoid distorting or marring the moldings when removing them from the mold.
92. Learn the causes and cures of the common difficulties in molding practice.
93. Do not cut the curing time or otherwise change the molding conditions without checking the results thoroughly. Thermosetting materials not cured long enough may lose the heat or water resistant qualities or they may not shrink to the dimensions required. Thermoplastics, injection molded, may develop air bub-

bles from too rapid loading, or they may shrink too much due to being removed from restraining cores too soon. Overcuring or overheating may cause color changes which may be cause for rejection.

94. Good housekeeping is an essential factor in good molding practice.
95. Lubricate ejector mechanisms occasionally to keep them operating freely. Do not lubricate excessively so the grease or oil works its way into the mold cavities where it can contaminate the molding material.
96. See that the molding machine is lubricated properly and is kept in good working condition.
97. Be sure the ejector pins are of the correct length and are adjusted correctly. Check the ejector space frequently to be sure there is no flash under the ejector or knockout plates to prevent their seating properly.
98. Use a mirror to inspect the portions of a mold cavity which cannot be seen directly when the mold is in the press.
99. Be sure to clean, polish and grease a mold after removing it from operation and before storing it. If repairs are required, they should be made so the mold will be ready to produce when it is taken out of storage again.
100. Study the available data thoroughly before beginning to lay out the estimating work. Ask for more if there is not sufficient data to make a good proposal.
101. Study the part to select the best method of molding it and the best arrangement in the mold.
102. Figure the number of cavity impressions required to allow production rates to be maintained on the equipment available.
103. Make a sketch of the proposed mold, and figure roughly the space requirements.
104. Calculate the steel requirements to determine the material costs.
105. Estimate the cost of the mold. A thorough knowledge of mold sinking methods is required, and so is knowledge of the specific equipment available for building the mold.
106. Compute the weight of the molded piece. For this operation it is well to assemble mathematical tables of the most convenient form to suit the individual estimator. Many times it will be possible to work out formulas for volumes and areas not commonly given in standard mathematical tables. These special formulas, if kept on file, will greatly assist in future jobs.
107. In figuring the total material requirements for the molding, add a reasonable amount for rejects and waste material. Rejects may run from 5% to 30%, depending upon the complexity of the molding, the tolerances required, the number of finishing operations, and the kind of material to be used. Waste may run to 5% or more.
108. Outline the molding, finishing and inspecting operations.
109. Break down each operation into as many elements as are required to provide a basis for accurately estimating the time involved. Accumulated experience will be sufficient to allow certain operations to be blocked off at so many pieces per hour, while some complex operations will have to be broken down completely even by the most experienced estimator. It is best to break down in case of doubt.
110. Make allowance for personal time, set up time, repair time, and loss of production due to damaged cavities in determining net rates of production. One way to determine a factor for converting gross rate to net rate is to time out a few jobs while they are running and then check the actual production over an average 24-hour run and over the total run. The actual rate divided by the stopwatch rate will be a fairly accurate factor to apply.
111. Set up an estimating form which will include all of the items which enter into the final cost. Lay it out conveniently so the items follow along in a logical manner, and so each succeeding item may be obtained from what has been computed before it.
112. Government price control regulations require uniformity and consistency in the steps leading to selling prices.

INJECTION MOLDING

OF THERMOPLASTIC MATERIALS*

John Pouhe and J. A. Kempf

Chicago Molded Products Corp.

THE mold used for injection molding of thermoplastic materials is made of steel and consists of two main sections. The first is made up of the plunger anchor plate, the plunger and the injection core. The second is the cavity section, with its die shoe and support, and with the knockout bar arrangement channeled into the die support.

On the cavity side of the mold are arranged the sludge pit, to trap the slug of cold, hardened material forced out at the beginning of the injection stroke; the runners through which the material flows to the cavity or cavities; and the gate through which the material enters the cavity from the runners. In the lower cavity, there are vents at the points farthest from the gate entrance, or directly opposite; these prevent the trapping of air which might produce a burn spot on the molded piece.

Ejection Mechanism

The knockout arrangement is generally built so that the knockout pin marks will be at points least objectionable on the piece itself. The knockout pins mounted on the knockout bar telescope through the cavity so that their ends are flush with the inside wall of the cavity.

In cases where marks made by knockout pins would prove objectionable in the molded piece, a stripped plate mechanism is often provided to remove the piece from the cavity side of the mold.

Finishing

The only basic finishing operation required is simply the removal of the gate, accomplished either by breaking or cutting from the piece. The surface finish is such that no buffing or polishing is necessary.

Many supplementary operations can be performed, however, where circumstances make their use advisable. The commonest of these are: sanding down the gate mark to blend it as much as possible with the finish of the part; drilling operations where holes cannot be provided in the molds; tapping of threads, where these cannot otherwise be provided for; spraying and hand-brushing of paint on characters and engraved portions; and buffing of sanded surfaces for blending. In drilling operations, coolants should be used to prevent the generation of heat which would cause the material to flow. Likewise, buffing should be done with extreme care to prevent burning or peeling of the material.

Cementing can be successfully accomplished in assembly operations. The binding agent which is used acts as a solvent on the parts being cemented, thus providing a very strong bond between the parts. Swaging or riveting can also be accomplished by the proper application of heat.

*This article is reprinted from "Plastics Progress", published by the Chicago Molded Products Corp.

Salvaging Material

In many instances the sprues and runners may be removed at the press and immediately placed in the hopper for remolding. In other cases, it is necessary to regrind the sprues for remolding, taking care that no dirt or foreign particles become mixed with the ground material. In the case of thermoplastic materials, no appreciable difference results from the grinding and remolding of the material. Thus all materials can be conserved. The only waste results from the presence of dirt or other foreign matter in the material and from the cleaning of the chamber when the charge is changed from one material or color to another. In the operation of the press, care must be taken at all times to avoid mixing one material with even a small quantity of another, as the different types of material, even though identical in color, will not blend or mix. Even a slight amount of contamination will waste the entire quantity of material in the chamber.

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Limitations

Today the field of injection molding is broad and is constantly growing. To be sure, there are certain limitations. The size of the available press equipment definitely limits the size of the parts which can now be successfully molded. The larger equipment that is expected in the near future, however, will remedy this situation.

The characteristics of thermoplastic materials themselves impose other limitations. For example, certain chemicals and compounds have a tendency to dissolve or attack the material, and these, of course, cannot be used. Moreover, since the temperature at which most commercial thermoplastics begin to soften is well below 200° F, these materials are not suitable for use where higher degrees of heat will be encountered.

Advantages

On the other hand, the advantages of injection molding are great. Among them are the comparatively low initial mold cost; high speed production; low overall operating cost; low finishing cost; and a uniform density of parts not obtainable by the compression molding process. In addition, no preforming or preheating of the material is required.

Future

Today, the number of successful applications for injection molded thermoplastics runs into the thousands. Among the wartime applications, we find windows for airplanes, lenses for gas masks, liners for helmets, military first aid kits, to say nothing of pipe connectors, fittings, couplings and valves, electrical insulation, connector blocks, etc. The list is still growing.

Much study and research are now being devoted to the injection molding of thermosetting materials. Today, thermosetting materials are being molded commercially by the injection method, and while the technique still has very decided limitations, it seems certain that most of these will soon be removed. It is safe to predict that in a matter of months, at most, we shall be molding thermosetting materials with the same speed and facility with which we now mold thermoplastics.

Future possibilities of induction heating

Frank W. Curtis, Chief Engineer
Van Norman Machine Tool Co.

From a paper presented at the Westinghouse Machine Tool Forum, held April 7, 1943

WITHIN the near future, metal working plants throughout the country, engaged in high or low production, will adapt themselves to methods of heating metals for hardening, brazing, soldering, forging and melting that their most active imagination could not have thought possible a few years ago. The process, that of high-frequency induction heating, is going to result in the development of new manufacturing techniques that will offer two outstanding advantages to industry, an economical cost of heating metals and a high rate of production with uniform results.

Induction heating units, briefly speaking, comprise a series of electrical units that convert the current of the input-line-voltage to a high-frequency current, which in turn is coupled to an inductor or heating coil. The part to be heated is placed within the coil, but does not become a part of the closed electrical circuit. When power is applied to the circuit, however, heating of the workpiece begins immediately through induced currents of high frequency generated from the induction coil. As illustrated in Fig. 2, water passes through the induction coil, when in use, to keep it cool and the only heat generated is into the workpiece itself. The coil is wound to fit the contour of the work, generally with a clearance of about $\frac{3}{32}$" to $\frac{1}{8}$" in between.

Induction heating units for industrial applications can be either of the low or high frequency type. Those operating at lower frequencies operate at about 9,600 cycles, as compared with frequencies of about 300,000 cycles or more, with spark-gap and oscillator-type units. In the use of a higher frequency convertor is the advantage of obtaining a skin or shallow surface heating effect, which is so often desirable in connection with hardening operations.

With the use of high frequency current, heat can be inducted to a predetermined area of a metal part requiring localized hardening, thus eliminating the expense of heating the entire part. Likewise, the heat can be controlled to the depth desired even to the point of heating certain small types of parts throughout, in which case the core or center-section has a tendency to heat by conduction from the outer surface which, in turn, is heated by induction.

Another outstanding advantage of high frequency heating is that parts of irregular shape, such as cams, can be heated uniformly around the surface if the variation in contour is not too severe. For example, in hardening a gear with medium pitch teeth the heat pattern very definitely follows the contour of the tooth so that hardening can be confined to the wearing surfaces without impairing the toughness of the inner portion.

Case Hardening

Case hardening is a very common form of heat treatment for metal parts and is, perhaps, one of the most outstanding applications for high frequency induction hardening when compared with former methods. The usual practice has been to use a low carbon steel with a carbon range of .10 to .20; carburize in containers or in a gas charged furnace for several hours—depending upon the amount of penetration required and finally reheating the part and quenching in oil or water as may be needed. Sometimes, this treatment is followed by a draw where a modified hardness is desired. In other cases, where hardness is

to be limited to certain areas of the part, it becomes necessary to remove some of the carburized sections before hardening, or to copper-plate the entire part and remove the plated area of the surfaces to be hardened before carburizing—either method of which adds to the manufacturing cost.

With the induction heating process, a steel with a carbon range of .40 to .50 is used; heating is localized to the area to be hardened without any appreciable effect to the remainder of the part; then, the heated surface is quenched as required. Practically no scale is formed during heating. Warpage and deformation are exceptionally slight and in most cases do not exist; drawing becomes unnecessary because the entire part has not been subjected to heat, thus precluding internal strains. Likewise, there is a substantial saving in cost, largely through the elimination of carburizing, as well as in the cost of heating for hardening. A comparison of costs for a gear on which only the teeth are required hard is shown in Fig. 3, resulting in the saving of 43 percent through the high frequency induction heating method.

The analysis includes the cost of steel in both cases because this difference has a relation between carburizing and induction hardening costs. There is only a fraction of a cent per pound difference in cost between the higher and lower carbon steels, but the carburizing cost runs about .04c per pound. The cost of heating differs, too, since only a portion of the part is heated when induction hardening is applied and the operating cost of the unit is comparatively low.

A gear of the size shown can be hardened in about 30 seconds floor-to-floor time, which includes 15 seconds for heating, 8 seconds for quenching and the balance for loading.

Fig. 1

Control of Hardness

Since the hardening cycle of a high frequency heating unit is controlled by an automatic timer, it is possible to vary the hardness of a part, one way or another as may be desired, by a slight change in the heating and quenching time cycle. Assume a shaft 2″ in diameter is to be case hardened $\frac{1}{16}$″ deep at one end to 55 C Rockwell, the cycle would be to generate heat for about 10 seconds, a water quench for 6 seconds and with the timer so set, piece after piece would be produced to this hardness with no appreciable variation. If a higher hardness were desired for the same piece, say 60 C Rockwell, this could be accomplished by either increasing the heat cycle slightly to about 11 seconds, or by increasing the pressure of the quench and duration of flow slightly, or perhaps both. If, on the other hand, a lower hardness were wanted, the length of quench could be reduced a second or so, or a half-second to a full-second delay could be incorporated between the end of the heat cycle and the start of the quench. If a relatively low range hardness is required, it is possible to reduce the length of the quench materially so that the workpiece would be removed from the induction coil while still fairly hot, from which temperature it would draw itself down to the desired hardness. To go from one extreme to the other, heating a piece without any quench would result in annealing and heating a piece and applying a full quench would result in maximum hardness. Therefore, by varying the heat and quench cycles, most any range of hardness can be obtained at will.

Generally speaking, most manufacturing-type steels can be hardened by high frequency induction heating, providing the carbon content is sufficient to produce hardness by quenching. With oil hardening steels, provision would have to be made to drop the heated piece into oil. With water quenching steels, a suitable holding fixture with a quench ring and an induction coil can be supplied so that the entire hardening operation is handled with the workpiece in one posi-

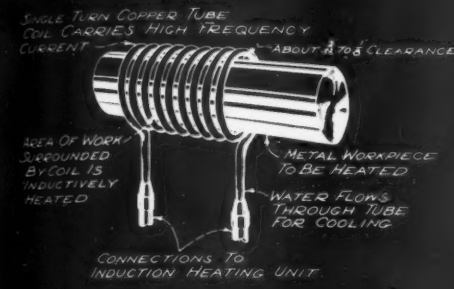
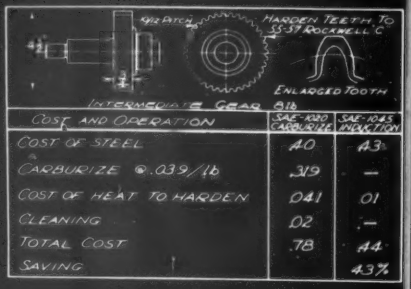

SINGLE TURN COPPER TUBE COIL CARRIES HIGH FREQUENCY CURRENT
ABOUT 1/8 TO 3/8 CLEARANCE
AREA OF WORK SURROUNDED BY COIL IS INDUCTIVELY HEATED
METAL WORKPIECE TO BE HEATED
WATER FLOWS THROUGH TUBE FOR COOLING
CONNECTIONS TO INDUCTION HEATING UNIT

Fig. 2



COST AND OPERATION	SAE-1020 CARBURIZE	SAE-1045 INDUCTION
COST OF STEEL	.40	.43
CARBURIZE @ .039/lb	.319	—
COST OF HEAT TO HARDEN	.041	.01
CLEANING	.02	—
TOTAL COST	.78	.44
SAVING		43%

Fig. 3

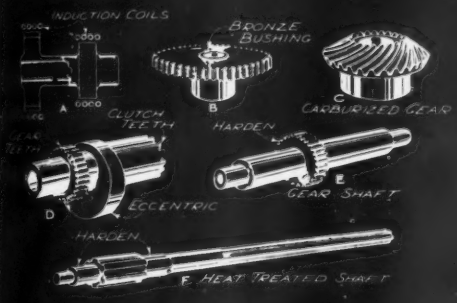


Fig. 4

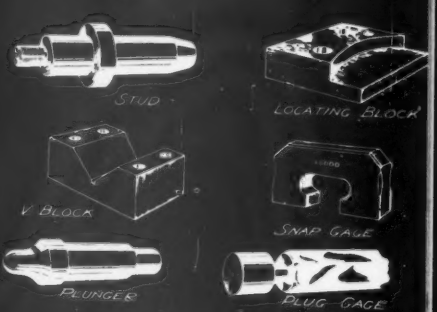


Fig. 5

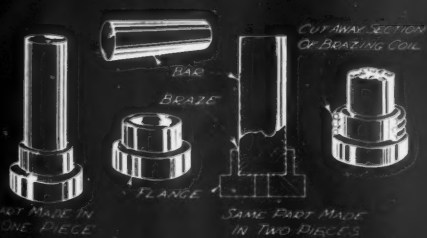


Fig. 6

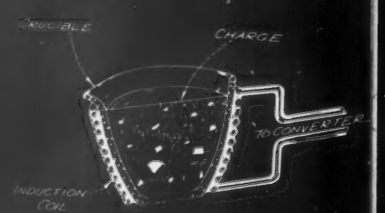


Fig. 7

tion. Such a fixture is shown in Fig. 1, the part being a spur gear.

Miscellaneous Hardening

Other hardening operations showing the scope of high frequeney induction hardening are shown in Fig. 4. The cluster gear at *A* has both gear sections hardened, each being handled separately which is the usual practice with parts of this kind. The gear at *B* is provided with a bronze bushing, which can be pressed into place before cutting of the gear teeth since the heat generated during induction hardening will not reach the center portion of the blank. With induction heating, it is also possible to harden carburized parts such as the spiral bevel gear shown at *C*. This procedure is sometimes necessary on spiral gears because the eddy currents of the high-frequency current cause heating more on one side of the teeth than on the other.

Differential hardening, producing different degrees of hardness on the same piece, is also possible with high frequency induction heating. On the part shown at *D*, the gear teeth are hardened to 54 C Rockwell, the eccentric to 62 C, and the clutch teeth to 57 C. With parts as shown at *E*, localized hardening by induction has many advantages, the outstanding being the absence of warpage which eliminates a costly straightening operation. Parts can also be heat treated, to say 32-34 C Rockwell, then localized-hardened, such as in the case of the shaft shown at *F* which has two surfaces hardened to 62 C Rockwell without affecting the heat treated portions.

While a steel having .40 carbon is satisfactory for high frequency hardening, it must be remembered that carbon has more influence in connection with hardening than the addition of alloys. Even though a steel with a carbon content of .35 can be successively induction hardened, a steel with higher carbon is preferable, especially since the hardness can be controlled by means of timing as has already been explained. A very practical water quenching steel for induction hardening is X-1340, now SAE C-1141. Because of the presence of manganese and sulphur in this grade of steel, it has excellent machining qualities, far better than either SAE 1040, or 1045, and as far as can be determined the manganese and sulphur do not have any effect on hardenability with induction heating.

An ideal steel for high frequency induction hardening applications that has not yet been made, but which can well be visioned as a general all-purpose steel, would be an X-1350, or perhaps X-1360. With good machinability and with suitable response to induction hardening, as it no doubt would possess, this steel could well fill the requirements for a very broad range of machine parts in many industries.

Toolroom Uses

Before long, induction heating will find many uses in modern toolrooms and to some extent may change our principles of tool design. Fixture components, such as clamps, locating blocks, studs, bushings, V-blocks, plungers, etc., can all be hardened by the induction process. Where speed is a factor, no other method would prove faster or better. A variety of tool and fixture parts suited to induction heating are illustrated in Fig. 5. Another possibility in this connection is the hardening of fixture parts after they have been assembled to the base or body unit.

The wide scope of brazing, made possible by induction heating, will have an effect on engineering design. Parts now machined or forged in one piece may well be made of two or more pieces and joined together by induction brazing with, of course, a direct saving in material cost. Such an example is shown in Fig. 6, representing a flanged shaft which could easily be made in two pieces, then joined together by induction brazing. The induction coil is made to surround the assembled pieces, which are centralized in and supported on a fixture. A formed ring of a small diameter brazing rod is placed on the flange, which when heated flows into the joint faces of both members and forms a solid bond.

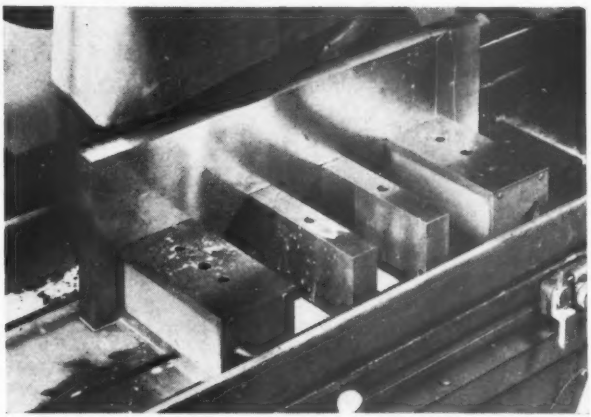
Melting

Another practical use for induction

(Continued on Page 236)

ONLY SECONDS REQUIRED

For either Vertical or Horizontal Set-ups



The principle of "Magnetic Body-Flo" is applied by Anderson & Brown Magnetic Chucks.
Two 8" chucks and parallels used on table 12" in width.

★

Holding Work Magnetically, Is Expanded with Anderson & Brown Magnetic Chucks

The wide acceptance of Anderson & Brown Magnetic Chucks in defense operations reveals the present urge for greater use of magnetic holding methods; for holding devices that are flexible and adaptable. With sizes ranging from small to large, the Anderson & Brown Chucks offer a means of modernizing your holding methods.

It will pay you to investigate.

Send for "Magnetic Chucking Revolutionized."

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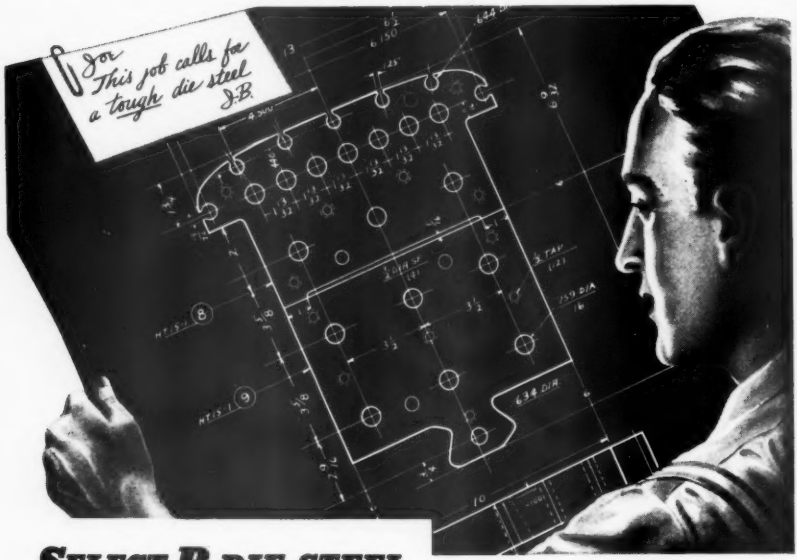


SELECT B DIE STEEL

... for toughness

"My problem is simply this: I have to choose a die steel that is tough and yet withstands considerable abrasion." So said a perplexed die shop superintendent recently to our metallurgical service man. "And don't forget," he added, "it has to machine easily, must be non-deforming and can't be ground after hardening—so the die must be free from scale or decarburization after heat treatment."

"Well, here is the answer," said the Latrobe Metallurgical Service Man. "It's *Select B* . . . a tough die steel that won't deform and will withstand abrasion. As far as heat treating, that is easy: Pack the die in sifted grey cast iron chips, dry charcoal or spent carburizing compound. Cast iron chips will prove preferable, since they won't build up carbon and cause brittleness of cutting edges.

"Since the dies are of a rather intricate nature, preheat at about 1400° F. As soon as they have become heated to this temperature bring furnace up to 1750-1775° F. Hold for just sufficient time for the container to become thoroughly heated, then remove the part and air cool in still air.

"When you can just about pick the dies up with your bare hand draw them at 900° F. The thickness being about 2½", hold for about four hours at this temperature. This will give a hardness of about Rockwell C-58 with the necessary toughness."

The result: This Company greatly simplified their die machinery problems, the production was increased and a substantial saving in their die steel costs was secured. It's a simple illustration of the timely help you can get to meet today's vital production problems with Latrobe Metallurgical Service. It's a technical help you can feel free to use. A special bulletin on "Select B" is available.

LESCO

TOOL STEELS FOR VICTORY

LATROBE

ELECTRIC STEEL COMPANY

MAIN OFFICES and PLANT . . . LATROBE · PA·

Industrial Digest

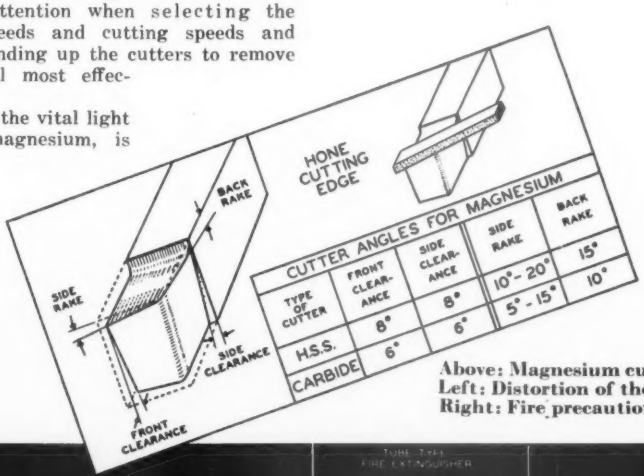
TOOLING • PRODUCTION • WAR NEWS • PUBLICATION REVIEW

Machining Magnesium

METALLURGICAL war developments of metals and metal alloys, so important to the nation's superiority in arms and ammunition manufacture, have brought new problems to the men whose job it is to cut the material into finished parts, to new limits of accuracy and finish. These metal developments and improvements call for special attention when selecting the proper feeds and cutting speeds and when grinding up the cutters to remove the metal most effectively.

One of the vital light alloys, magnesium, is probably the freest cutting of all metals when properly machined. Certain characteristics of this metal must be taken into consideration, however, for successful high precision work. If resourceful operators are aware of these properties, the problems of machining it naturally become greatly simplified.

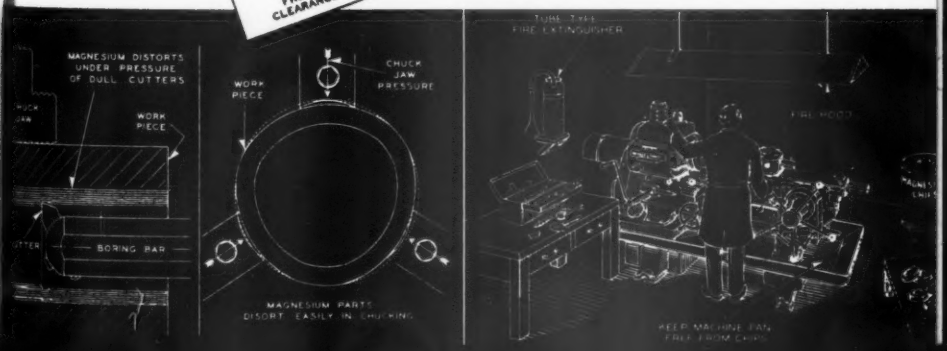
Magnesium expands much more with heat than most metals. It distorts or springs easily under cutting and chucking pressure. Furthermore, it is spongy —drilled or bored holes may close up



CUTTER ANGLES FOR MAGNESIUM

TYPE OF CUTTER	FRONT CLEARANCE	SIDE CLEARANCE	SIDE RAKE	BACK RAKE
H.S.S.	8°	8°	10°-20°	15°
CARBIDE	6°	6°	5°-15°	10°

Above: Magnesium cutting chart
Left: Distortion of the metal
Right: Fire precautions


MAGNESIUM DISTORTS UNDER PRESSURE OF DULL CUTTERS
WORK PIECE
BORING BAR
WORK PIECE
CHUCK JAW PRESSURE
MAGNESIUM PARTS DISORT EASILY IN CHUCKING
TURN TO FIRE EXTINGUISHER
KEEP MACHINE PAN FREE FROM CHIPS

slightly undersize unless cleanly cut.

Magnesium can be machined at 500 to 800 fpm with high speed steel cutters and anywhere up to 1500 fpm with carbide tipped tools. Feeds selected can be as coarse as possible consistent with the finish required and range anywhere from .005" to .075". For a smooth finish, cutters should be kept sharp in machining magnesium metal. Honing or lapping the cutting edge after grinding is a "must" when preparing cutters for magnesium.

The observation of certain safety precautions in machining magnesium is imperative. Magnesium chips are like flashlight powder and must be dealt with accordingly. Water coolants cannot be used since magnesium burns more readily under water than in the open air. The material must either be cut dry, or, where necessary, mineral cutting oils may be applied.

The cut should not be allowed to dwell, drag or rub against the work. After the feed is disengaged, the tool should immediately be withdrawn from the work. The machine should be kept entirely clean of chips, and the chips piled in closed containers away from the machine itself.

Since water cannot be used to put out any fire that might develop, powdered soapstone or a commercial extinguisher should be within easy reach at all times.

This is a digest of an article appearing in "Blue Chips", published by The Warner & Swasey Co.

Industrial Incentives

Recognition of the human factors involved in the battle of production has prompted the Navy Department to lay special stress on the use of industrial incentives. Rear Admiral C. H. Woodward, USN (Ret'd), Chief of the Navy Industrial Incentives Division, declares that through the proper use of incentives, much can be done to reduce absenteeism, work spoilage, rejects, waste, general disinterest toward the job, restlessness of labor and other major personnel and morale problems.

"Non-financial appeals may be made to man's patriotism, his desire for fair play, his appreciation of desirable surroundings, his confidence in those above him, his loyalty, his sense of duty, his desire for achievement, his competitive spirit, his desire for a good reputation, his ambition for promotion, his creative impulses, his desire for self-development and his instinct for self-preservation. The proper appeal to those motives can be made just as effective as any money appeal."

Unique Welding Show

Invitation to an unusual show, scheduled for some time in June at Cleveland, Ohio, is extended by the Moslo Machinchinery Co. to officials of foreign purchasing commissions, welding engineers and large users of welding equipment. For the first time on record, the processing of welding rod, complete in every detail from cutting machine to packaging, will be demonstrated under one roof.

The plant to be displayed is one of several sold by Moslo to a large foreign power. It will be in full operation, actually processing wire.

Interesting feature of the show, from the viewpoint of those not completely familiar with actual rod processing, is the amount of machinery necessary to accomplish the seemingly simple job of coating rods with flux and brushing a little from the ends, where electrical contacts must be made. Altogether an assembly approximately 100 feet long is required. Inspection is being arranged by appointment only.

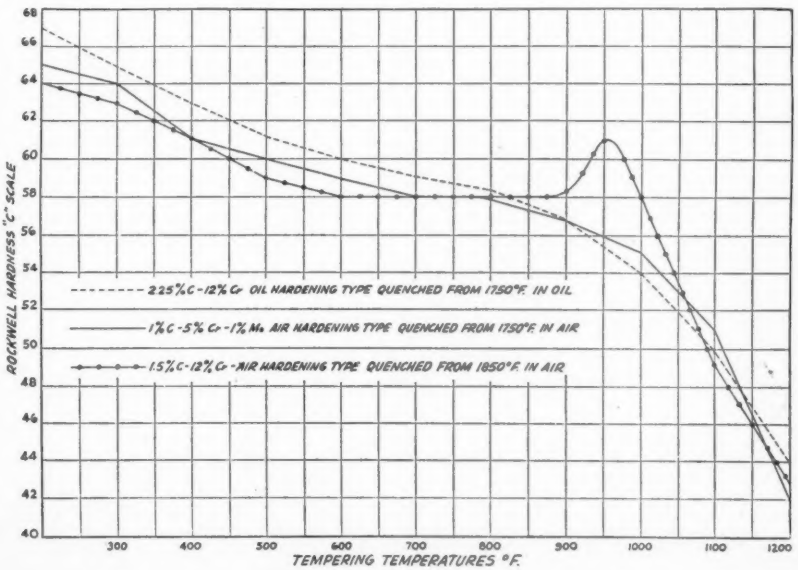
Heat Treatment of Air Hardening Steels

The proper time to temper an air hardening tool steel is the same as any other tool steel—when it can comfortably be held in your hand. The tool should not be tempered when hotter than this because it has not fully hardened. On the other hand, the steel should not be allowed to reach room temperature because the hardening strains may increase to a point where the tool will crack. The tempering of blanking or trimming dies or punches, gages, etc., made of 1% carbon—5% chromium—1% molybdenum air hardening steel is usually carried out at 350° F. to 400° F., to obtain a hardness of 61-62 "C". This steel does not possess a secondary hardness range, therefore the hardness drops progressively as the temperature is increased. Because of the austenitic tendency of this steel, a long draw is desired. Even small pieces should be given a minimum draw of two hours, while large sections should have at least four to six hours.

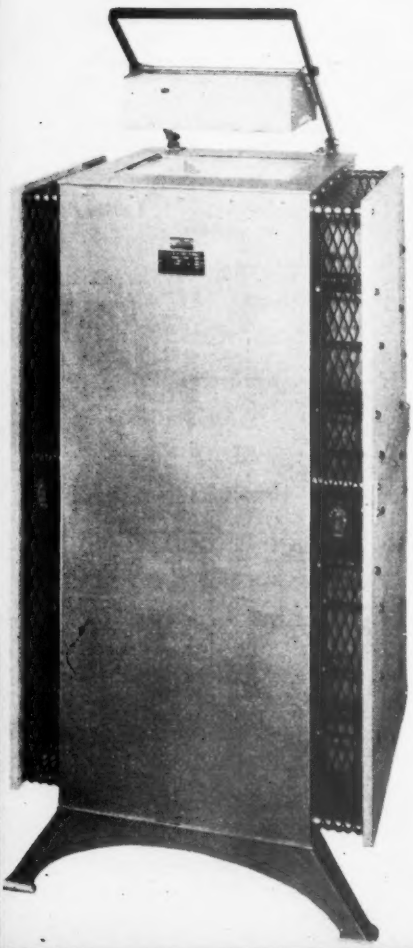
The chart below shows the hardness obtained at various draw temperatures on the 1% carbon—5% chromium—1% molybdenum air hardening type in comparison with the high-carbon high-chromium 1.5% carbon—12% chromium air hardening type, and also with the high-carbon high-chromium 2.25% carbon—12% chromium oil hardening type.

For the best results, the furnace atmospheres and packing materials used for the hardening of the 1.5% carbon—12% chromium, high-carbon high-chromium type of air hardening steel should be the same as those recommended for the 1% carbon—5% chromium—1% molybdenum air hardening type. Inasmuch

(Continued on Page 185)



Progress on Parade



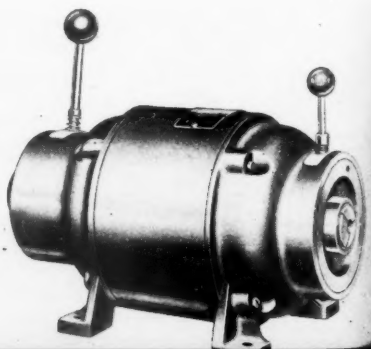
DEVELOPED by customer request, the latest addition to the Sentry line of electric vertical high speed steel hardening furnaces will accommodate tools up to 4¾" in diameter and up to 36" in length. The furnace shell is of steel with heavy top and bottom plates. Amply insulated, it will attain a top temperature of 2500° F. Recent tests showed a heating time of only 1 hour and 15 minutes to heat from room temperature to 2350° F.

The Globar heating elements are spaced on both sides of the Muffle to provide even heating. The lift type door is so arranged as to swing up and back away from the Muffle opening, and is balanced so that the hot surface is not exposed to the operator.

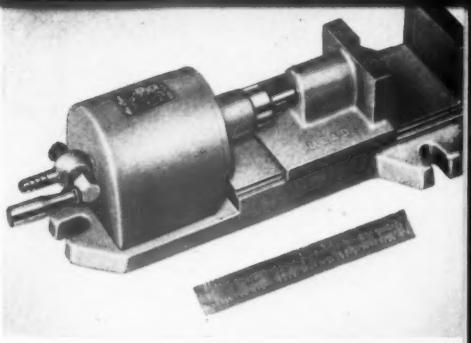
For further information about this Size No. 4B, Model "YP" Furnace, write to The Sentry Co., Dept. T, Foxboro, Mass.

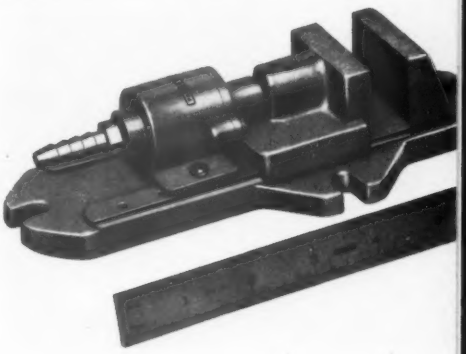
TO permit polishing a portion of a long piece of work up to the maximum capacity of the lathe, the Crozier Machine Tool Co. has produced a new polishing lathe with a clearance hole through the entire machine.

Work can be loaded and unloaded while the spindle is in rotation. Positive opening and closing of the collet is provided through a double-face cam operating mechanism which is hardened and precision ground. A switch and mechanical brake control makes the machine perfectly adaptable to work which can be loaded better when the spindle is stationary. The entire motor is dust tight, excluding all abrasive material—a highly important feature in polishing lathe work. For full details write The Crozier Machine Tool Co., Dept. L, Hawthorne, Calif.



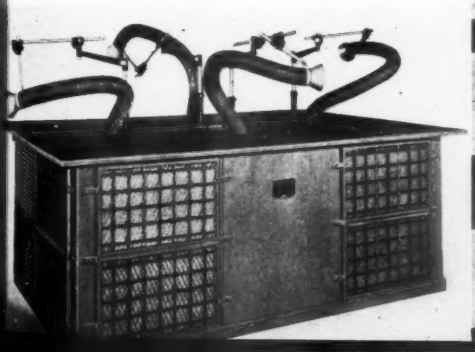
TWO new Mead air vises are shown in the photos top right. The Model 42 (first) can be furnished with either hand valve, as shown, or with one of two types of foot control valve. It features a 2" stroke, two jaw settings with capacity up to 3¾" and four bolt lugs. Model 10 (second), an unusually small unit, facilitates a variety of light drill press operations, bench assembly jobs and light milling jobs such as screw slotting operations. Write to Mead Specialties Co., Department 173, S. Market St., Chicago, Ill.





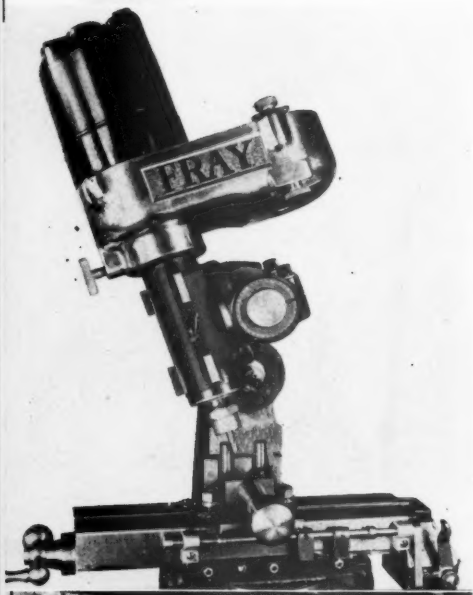
ONE girl operator can both buck and rivet in a single operation with this new Aero bench model automatic rivet bucker. The tool uses a standard rivet set that is synchronized with an air cushioned bucker. When the rivet set contacts the rivet, the bucking bar is always against the shank, with no predetermined setting required. Write to Aero Tool Co., Dept. 17, Burbank, Calif.

AS an aid in the protection of manpower, Schmeig Industries offer a new four-station grinding bench, with integral dust collector which they claim will give full protection against dust hazards incident to grinding operations. The new unit (illustrated below) is designed for use with portable grinders, on non-hazardous materials. Variations in design are available to suit production requirements. For complete information, write Schmeig Industries, 343 Fiquette Ave., Detroit, Mich.



THE new Jansson height gage, designed especially for use in jig and fixture making and for general layout and inspection work, is available in three standard sizes—12″, 18″ and 24″, English or Metric measure.

The company—already manufacturers of a complete line of precision gage blocks, tri-squares, thread and cylindrical plugs and rings and a variety of special profile, snap and flush-pin gages—used the same precision in the calibration of these gages. Further information may be obtained from Jansson Gage Co., 19212 Glendale Ave., Detroit, Mich.



THIS new Fray vertical milling attachment, for use on both bench and floor model milling machines, will handle up to ½″ end mills in tool steel. Designed for quick change of cutting tools, this Type F attachment is equipped with a spanner to hold the spindle while tightening and loosening the collets. For a folder giving further details, write The Fray Machine Tool Co., Inc., Dept. J, Glendale, Calif.

A SPECIAL live center set-up in precision thread grinders worked out by The Sturdimatic Tool Co. has appreciably reduced scrap in the production of vital aircraft engine parts. The illustrations below show, left to right, a battery of Excello Thread Grinders, the set-up in operation, and the operator putting another part on the specially designed live center. Further information will be given by The Sturdimatic Tool Co., 5222 Third Ave., Detroit, Mich.

SAVE TIME AND MONEY THESE 5 DIFFERENT WAYS

This small compact electric furnace is inexpensive, handy and easy to operate—ideal for small tool and die shops—saves time these five different ways:

1. Eliminates delays in sending small machine parts out to overcrowded commercial heat treaters.
2. Saves time and expense of drawing or tempering small metal parts in large furnaces.
3. Cuts handling time when normalizing or annealing small parts. No waiting.
4. Conveniently available for pre-heating for subsequent high-speed hardening.
5. Eliminates shut downs and delays in servicing emergency repair orders.

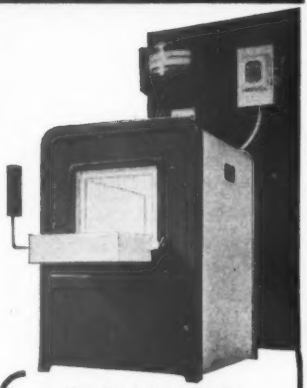
AVAILABLE IN TWO SIZES

Type	*Chamber Capacity*	*Amps 115 V*	*Watts*	*Amps 230 V*	*Price*
MH-3	8″W 6″H 14″L	29.6	3400	14.8	$124.00*
MH-4	10″W 6″H 18″L	....	4800	20.9	$191.00*

**Includes Hearth Plate*

MAX. SAFE TEMPERATURE—Continuous operation, 1750° F.; Intermittent operation, 1850° F.

AUTOMATIC CONTROL—Indicating Controlling Pyrometer—Thermo-couple and lead wire complete—$142.40.



REPLACEABLE HEATING ELEMENTS

Replaceable nickel chromium resistors embedded in rectangular refractory blocks. Elements form inner walls of furnace chamber, and may be replaced easily and quickly after removing rear panel — furnace structure remains undisturbed.

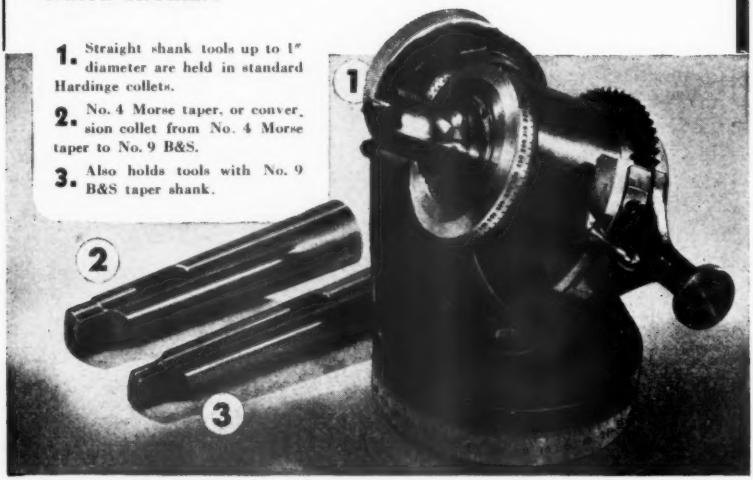
FREE—Complete data covering specifications, additional applications and ordering instructions are included in this new folder. Write for your copy today. Ask for Bulletin No. 50.

COOLEY ELECTRIC MANUFACTURING CORP.
215 S. SENATE AVENUE • INDIANAPOLIS, IND.

THIS UNIVERSAL PRECISION INDEXING HEAD

can be used on any tool or surface grinder!

It holds all the tools shown below, and can easily be adapted to hold many others. Graduated 360° in three planes, for every simple or compound angle. Vernier lever will rotate work collet between indexed points without changing index or location of tool in collet. Accurate . . . useful . . . adaptable. Prompt delivery. ***Write for illustrated circular.***



1. Straight shank tools up to 1" diameter are held in standard Hardinge collets.
2. No. 4 Morse taper, or conversion collet from No. 4 Morse taper to No. 9 B&S.
3. Also holds tools with No. 9 B&S taper shank.

CLEVELAND

TOOL ENGINEERING COMPANY

9105 DETROIT AVE. • CLEVELAND, OHIO

WOODY SPENCER SAYS:—

"YOUR HIGH SPEED TOOL STEEL SCRAP IS BADLY NEEDED... MAKE THIS YOUR CONSERVATION PROGRAM..."

1. Do not throw away any scrap.

2. Segregate high speed tool steel scrap from regular scrap metal.

3. When a reasonable amount has been saved, see that it gets back to the steel mills through the proper channels.

Do not return to Wood & Spencer.

You can cut down waste on taps by carefully selecting the right tap for every job. We'll be glad to help you . . . write on your company letterhead for our latest catalog.

"THE RIGHT TAP AT THE RIGHT TIME"

The Wood & Spencer Company

Cleveland, Ohio

L&I *reamers for best results.*

SMOOTHER SURFACE FINISH

L & I reamers have a cutting edge that is keener because it is ground on both faces.

LONGER USEFUL LIFE

L & I reamers are carefully lapped after the flutes have been ground.

EXTREME ACCURACY

The L & I process eliminates the distortion of flute structure that frequently occurs in the heat treating of small diameter, milled-flute reamers.

STRAIGHT FLUTE REAMERS IN DIAMETERS UP TO 1/4"

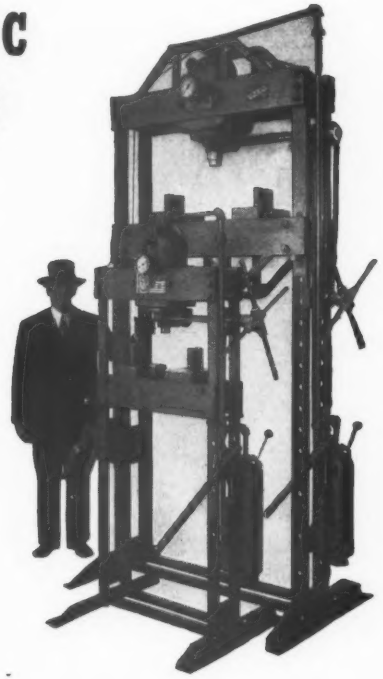
LAVALLEE & IDE, INC.

CHICOPEE, MASS.

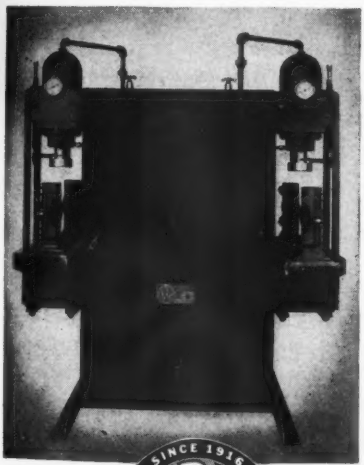
L&I

KRW HYDRAULIC ARBOR PRESSES

for War Production



Standard Hydraulic Presses in 25, 50 and 75 ton capacities. Special Presses engineered for specific war production needs.



The exclusive design features which have given KRW Standard Presses their reputation for speed and efficiency are available to war production manufacturers who require presses of special design. The illustration above shows a *special,* extra high 75 ton KRW Press in comparison with the Standard 25 ton unit. Opposite illustration shows a special, 4-man operated, air-oil Press used for bomb loading.

. . . KRW also builds bench-type Arbor Presses in 1/2, 1 and 3 ton capacities.

SINCE 1916 KRW A MARK OF DEPENDABILITY

K. R. WILSON

10 LOCK ST., BUFFALO, N. Y.

STATE

BORING AND REAMING BARS

A NEW TOOL

THAT SETS A NEW STANDARD FOR HIGH SPEED • HIGH QUALITY BORING AND REAMING

Seven Sizes Expansion Range

#0— 7/8" —1-1/16"
#1—1-1/16"—1-7/16"
#2—1-7/16"—1-7/8"
#3—1-7/8" —2-3/8"
#4—2-3/8" —3-1/8"
#5—3-1/8" —4-1/4"
#6—4-1/4" —5-1/2"

Designed with FOUR interlocking-adjustable cutters easily and accurately expanded or retracted by a single fine thread adjusting screw.

PROMPT DELIVERIES

For production jobs: — Standard size or special STATE bars engineered to specific requirements:—Permit faster operation and insure greater accuracy at lower cost.

For emergency use:—A complete set of STATE bars—covering all diameters from 7/8" to 5½" should be in every tool room. Seven tools may replace seventy or more.

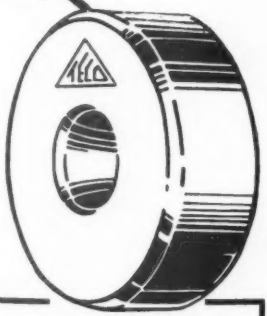
Available with high speed steel, cast alloy or tipped bits. Pilots — wear strips — or facing collars — to specifications.

STATE MANUFACTURING & CONSTRUCTION CO.
FRANKLIN · OHIO

CARTRIDGE CASE MANUFACTURERS — with increased production at stake, your best bet is TECO Carbide Dies. In America's leading ordnance plants, they are boosting output to new highs, producing millions of cartridge cases weekly.

Equipped with TECO Carbide Dies, your machines will maintain accurate, on-size production for much longer runs—produce smoothly-finished cases—eliminate rejects. The unusual capacity of TECO Carbide Dies is due to rigid control of every step in the manufacture of the carbide and fabrication of the dies.

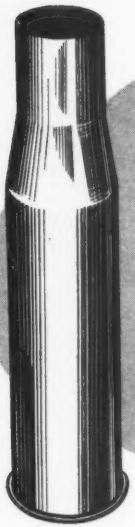
A test run will prove these facts in your plant. Our engineers will gladly discuss your needs.



DRAW DIES
NECKING DIES
SIZING DIES
TAPERING DIES
BULLET DIES
SWAGE DIES

TUNGSTEN ELECTRIC CORPORATION
574 39th STREET UNION CITY, N. J.
Branch Office: 2906 Euclid Ave., Cleveland, Ohio
Representative: Architects & Builders Bldg., Indianapolis, Ind.

TECO *Pioneers in Tungsten Carbides for over a Quarter Century* **CARBIDE DIES**



SPEEDING

Steel Shell Production

Gilron compounds are now doing a real job drawing steel cartridge and shell cases. Aiding in the development work, Gilron engineers have been instrumental in increasing production for leading manufacturers.

20 mm to 105 mm steel shell cases can be produced with the new water soluble non-toxic coating compound, thus eliminating copper plating.

Because of the high film strength, Gilron coating fluid completely eliminates scratching and scoring.

A convincing list of satisfied users will be furnished on request, together with complete production details.

Gilron

PRODUCTS COMPANY

1557 EAST 40th STREET · CLEVELAND, OHIO

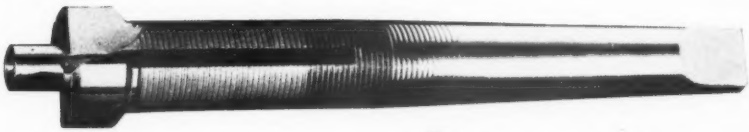
NEW

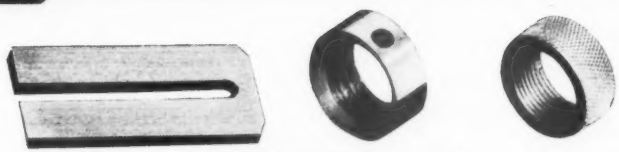
COUNTERBORE
and Spot Facer
WITH MOVABLE INSERTED CUTTERS

MADE IN 41 STANDARD SIZES — FROM 1″ TO 3½″ DIA.

only NASH-ZEMPEL has these 12 features

1. Cutter removed easily for sharpening.
2. Cutter always aligned accurately with body of bar.
3. Maximum cutter life.
4. Milled web locates fingers of cutters while cone nut centers rear of cutter.
5. Movement of cutter equals expendable portion.
6. Cutting edge of tool always in same place.
7. Chip clearance in bar—not in cutter.
8. Easy method of locking cutter securely.
9. Economical to operate — only cutter to replace when used up.
10. New cutter — means new spot facer or counterbore.
11. Pilot drilled and tapped to hold different size bushings.
12. Made in 41 standard sizes. Special requirements made to order.





SEND FOR DESCRIPTIVE LITERATURE

Send in sketch of your requirements and we will be glad to quote prices. Special sizes can be furnished with pilots, straight shanks or special tapers, other than the standard Morse tapers, which are listed on the specification sheet.

ACME TOOL CO. 200 CHURCH ST. NEW YORK, N. Y.

Kut Kost

- HIGHER SPEEDS
- HIGHER FEEDS
- INCREASED OUTPUT
- DECREASED COST

The New Centrifugally Cast Cutting Alloy Containing BORON

GRADE V: For heavy roughing on all types of high tensile strength materials (1/32" to 1/8" feed)
Rockwell "C" hardness 61-63

GRADE X: For medium roughing and semi-finish on all high tensile strength materials (.010" to .032" feed)
Rockwell "C" hardness 65-67

GRADE XV: For finishing cuts on all types of materials. Also roughing and semi-finish on low tensile strength materials such as bakelite, brass, bronze, aluminum, copper, etc.
Rockwell "C" hardness 68-70

RECOMMENDED SPEED INCREASES OVER HIGH SPEED STEEL:

Low tensile strength materials	100% to 300%
Cast iron and semi-steel	100% to 300%
Steel castings	50% to 200%
Tough alloy steels	100% to 400%
Stainless and manganese steels	100% to 500%

KUTKOST SOLID TOOL BIT PRICE LIST (*Now ready for delivery*)

Size	Price Each	Size	Price Each	Size	Price Each
¼ x ¼ x 2¼	$ .95	⅜ x ⅜ x 3	$1.65	½ x ½ x 4	$3.25
5/16 x 5/16 x 2½	1.25	7/16 x 7/16 x 3½	2.40	⅝ x ⅝ x 4	4.70

GENERAL TOOL AND DIE CORP.
553 PROSPECT ST. EAST ORANGE, N. J.

SAVINGS LIKE THIS-

CAN'T BE OVERLOOKED!

TO PRODUCE ONE WASHER THE OLD WAY

One Small Compound Die

REQUIRES 40 LBS. OF STEEL

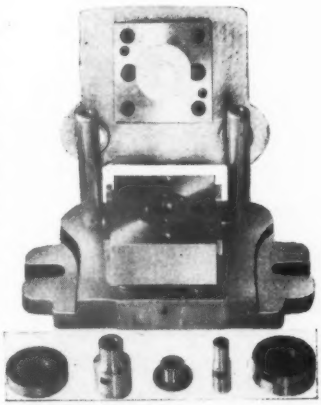
•

TO MAKE THE SAME WASHER THE HOVIS WAY

One set of interchangeable parts for a Hovis ¾-inch washer die, requires

ONLY 3 LBS. OF STEEL

Many companies are effecting remarkable savings by making washers the HOVIS WAY, using a few interchangeable parts. YOU CAN DO THE SAME! At a nominal investment, you can save the cost and materials required to make new dies for each new washer . . . have washers when you want them, in the quantities you need. Ask for details.



MADE IN FOUR SIZES:
¾" . . 1½" . . 2½" . . 4"

HOVIS
SCREWLOCK CO.
8100 E. Nine Mile Road
Van Dyke Michigan
Suburb of Detroit Phone Centerline 157

Write for Illustrated Folder

SAVE PRODUCTION TIME *with a* SHOPLIFTER

One man can handle heavy dies alone. Not necessary to stop other machines to get help.

MORE production per day from your machines if a Shoplifter is handy to do the heavy job of moving dies from storage racks to the press. In these times when maximum production of machines is of vital importance, much time and labor can be saved if the operator can handle the heavy work of changing dies without calling for help from other operators.

The Shoplifter is built for this job. Dependable and safe with a rated capacity of 500 lbs. (heavier machines up to 5000 lbs. can be furnished). Entire machine built of structural steel. Electrically welded throughout. Platform lifts 57" above floor and lowers to within 8¼" of floor. Overall height 72". Size of platform 24"x24" steel plate. Crank, up and down, hoist unit.

Price

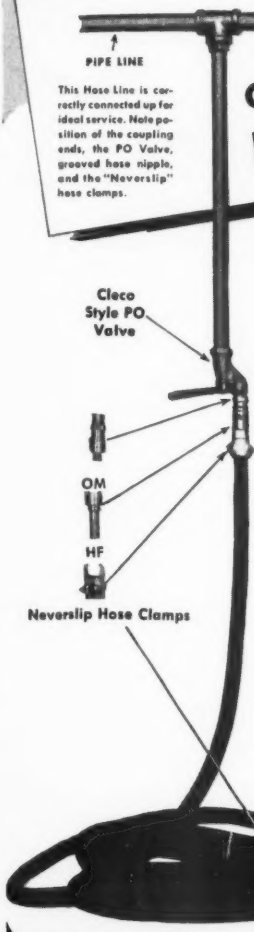
$147.50

ECONOMY ENGINEERING CO.

2659 W. Van Buren St., Chicago

IMMEDIATE DELIVERY

Every Compressed Air Line Needs BOWES COUPLINGS

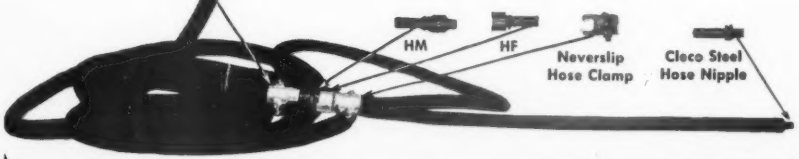

PIPE LINE
This Hose Line is correctly connected up for ideal service. Note position of the coupling ends, the PO Valve, grooved hose nipple, and the "Neverslip" hose clamps.
Cleco Style PO Valve
OM
HF
Neverslip Hose Clamps

★ Truly the coupling that pleases everybody, the famous Bowes Coupling is universally preferred for use on compressed air lines. Tough, durable and thoroughly corrosion-proof, these quick-acting hose couplings are also used on hose lines for gas, water, oils and other liquids.

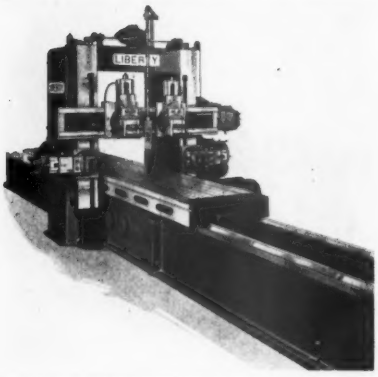
Bowes Couplings are absolutely tight under all pressures from 10 lbs. up. Mechanically locked, they cannot be disconnected accidentally. Yet they can be detached or connected at will—a simple push and quarter twist connects, while a slight pull on locking sleeve, with a quarter turn, permits instant separation.

Available in six styles and in many sizes, some of which are made in steel as well as brass. For complete information on Bowes Couplings and other Cleco hose fittings and sundries write for Bulletin 78A.

BUY U. S. WAR BONDS AND STAMPS



THE CLEVELAND PNEUMATIC TOOL CO.
3781 EAST 77th ST. *Branch Offices in All Principal Cities* CLEVELAND, OHIO
★



Liberty Introduces New Medium Duty Planer

FOR shops where the work cannot be handled by small standard duty machines and where heavy duty, slightly more elaborate planers would be unnecessary, this new double housing medium duty planer is offered by Liberty Planers.

With many of the features typical of other Liberty planers incorporated into its design, this machine is calculated to provide sustained accuracy over long and interrupted periods. The critical planer user will find it an efficient and economical machine tool.

The double length bed is of box type construction with pressure lubricated Vees, well ribbed cross walls and bottom mounting flanges. Housing faces are extra wide, providing bearing surfaces for cross rail.

Individually motorized for elevating, the deep box type cross rail is long enough to accommodate two heads, allowing either one full traverse across the table.

The planer comes equipped with extra strong, counterbalanced side heads on both left and right hand housings. The two rail heads, each equipped with a pneumatic tool lifter, have four-way power feed control with micrometer adjustment to both vertical and horizontal feeds. Added features are the wedge type clamping devices on the clapper devices.

For further information, write Liberty Planers, Department L, Hamilton, O.

You Save Plenty

when you buy a

HONAN-CRANE

"CONTINUOUS" OIL PURIFIER

● The saving in oil will, in most cases, pay for the original cost of equipment, plus operating costs.

In addition, you operate your equipment on clean fresh oil at all times. This will:

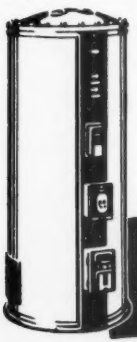
1— Reduce excessive wear on moving parts

2— Extend machine and tool life

3— Reduce operating and maintenance costs

4— Keep operating efficiency at a high level

Honan-Crane "Continuous" Oil Purifiers are now operating on every kind of equipment where oil is used. For complete information on technique of application and results accomplished write—



HONAN-CRANE CORP.

802 WABASH AVE.

LEBANON, INDIANA

Retracting and Repositioning Work Within .0002 OF AN INCH—By Push Button

The most frequently needed function in a precision boring machine is that of retracting the work to facilitate measuring and tool setting.

In the DeVlieg Jigmil, this function is automatic—by fingertip control. Operation of a push button unlocks the table and moves it by rapid traverse to the desired position for measuring. For repositioning, operation of a single push button will cause the table to return to its cutting position by rapid traverse, stopping and locking automatically. Uniformity of selected position for stopping and locking is dependable within .0002".

The DeVlieg Jigmil is a new type machine—has the spacing accuracy of a Jig Borer—Performance Qualities of a Milling Machine—Convenience and Flexibility of a Horizontal Boring Mill. All control is so centered and organized that the operator never has to take his eyes off the work.

Thus, the Jigmil fulfills the machine tool ideal—a powerful and accurate extension of the operator's hand.

Many machines show 75 per cent greater average daily productivity.

DE VLIEG MACHINE COMPANY
450 FAIR AVE. FERNDALE (DETROIT) MICHIGAN

Write for Circular
DEVLIEG MACHINE TOOLS

Michigan Tool Introduces Versatile Checking Recorder

HERE is an Automatic Gear Checking Recorder, put out by The Michigan Tool Co., with an exceptionally wide variety of use and high standard of operation. Although designed primarily for use with Michigan Sine-Line lead and involute checkers and for making permanent chart records of involute tooth forms and leads, it can also be applied to a miscellany of checking operations.

Operation of the recorder is based on the use of synchronous devices and only very simple changes are necessary to provide the required electrical connections between the measuring unit and the recorder.

This versatile Model B can be utilized for recording variations in dimensions of thread forms, for surface checking with parallels and for many other checking operations wherein a record of dimensions is desired. It may also be used for such typical applications as recording variations in gear or worm contours as determined by contour checker, recording eccentricity of worm gears, etc., and recording variations in helical lead of gears used in conjunction with lead checkers.

The entire checking recorder unit is mounted on casters for easy portability. Over the chart roll and recording pen is a hinged transparent plastic cover. A bar below the edge of the cover is slightly separated so that a complete chart may easily be torn off the roll.

Address The Michigan Tool Co., Dept. K, 7171 E. McNichols Rd., Detroit, Mich.

AMIC

●

COMPARATOR

WITH

TILTING

HEAD

●

A Precision Indicating Gage

Designed to replace flush pin gages. The ideal instrument for measuring lengths, depths and recesses. The tilting head permits the instrument to be set at any angle for rapid, precision checking of all components.

AMERICAN MEASURING INSTRUMENTS CORP.

240 West 40th Street **New York, N. Y.**

MANUFACTURERS OF
GAGES, JIGS, FIXTURES AND SERVICE TOOLS

Besly don't make all the good taps produced today, But

Besly Taps are all good Taps. Every step of our manufacturing process is closely watched to the end that Taps bearing the name "Besly" perform as they should.

When you think of tapping remember that Besly Taps will give you satisfactory, trouble-free production.

•

•

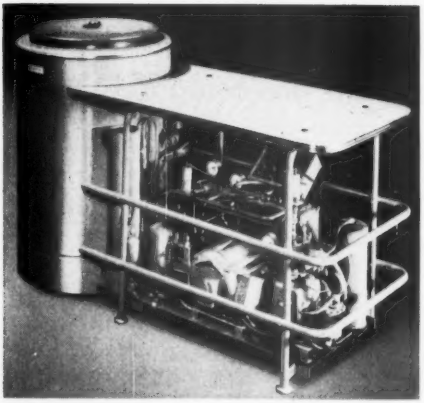
Send for CATALOG No. 67

It has a wealth of useful information for Tap users

CHARLES H. BESLY & COMPANY

118-124 NORTH CLINTON ST., CHICAGO, ILL.

FACTORY: BELOIT, WISCONSIN



New Deepfreeze Unit Has—70° F Range

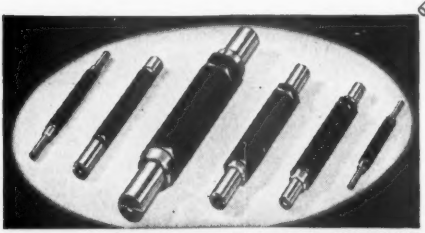
A WIDE range of sub-zero temperatures provides possibilities of extensive application in the aircraft industry for the new Deepfreeze Model D-70. Exceeding Government specifications for chilling units, this two-stage unit has a maximum capacity of —70° F and removes 800 B.T.U. per hour at that temperature.

With this range of sub-zero conditions this Deepfreeze unit is recommended for retarding the aging of aluminum rivets, for storing annealed aluminum alloy metals, for shrink-fit assembly of parts and for countless other applications. It has also been found dependable by manufacturers of chemical and pharmaceutical products.

Like other Deepfreeze chilling units, the D-70's chilling chamber consists of a double wall cold cylinder which entirely surrounds the walls of the chilling compartment. Interior diameter of the cylinder is 18", depth is 30". Ample sturdiness is imparted by the inside wall's 10 gage steel construction. And although Model D-70 gives over 24 sq. ft. of primary freezing surface and a capacity of 33 gal., it takes up very little space in the factory or laboratory; overall height is 37", length 67", width 36".

Further information will be furnished on request by the Deepfreeze Division of Motor Products Corp., 2301 Davis St., N. Chicago, Ill.

TURN EITHER PLUG END FOR END WHEN WORN AND YOU HAVE A **NEW** PLUG



DUBLIFE
REVERSIBLE
PLUG GAGES

Actually *more than doubles* precision-life of gage. Both "Go" and "No Go" plugs in same handle. Each easily reversed. Plugs securely locked by bronze collet.

Send for Complete Gage Catalog

Shows DUBLIFE sizes .030 to 1", and other gages A. G. Design. Wire or write

Originators and exclusive manufacturers of DUBLIFE Gages and UPPCO Finish

UNITED PRECISION PRODUCTS CO.

3516 W. BELMONT AVE. CHICAGO, ILL.

LAST YEAR'S BONDS GOT US STARTED

THIS YEAR'S BONDS

ARE TO WIN!

★ Last year nearly 30,000,000 workers were buying War Bonds through 175,000 Pay-Roll Savings Plans. At an average rate of practically 10% of gross pay!

This year we've got to top *all* these figures—and top them handsomely!

"But," you say, "there's a Pay-Roll Savings Plan already running in my plant."

Sure, there is—but how long since you've done anything about it? Check up on it today. If it doesn't show substantially more than 10%, it needs a thorough re-canvass!

And you're the man to start it! Organize a vigorous drive. Other plants are boosting their quotas to 12% and 14% of pay-roll. You can do as well, or better.

In plant after plant, the Pay-Roll Savings Plan gives labor and management a common goal. Company spirit soars. Production swings up.

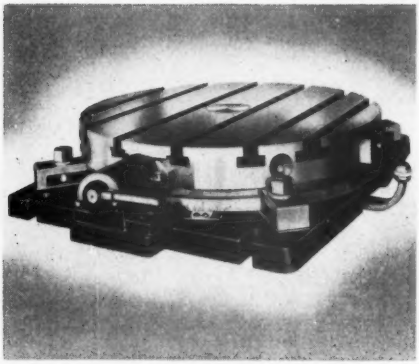
War Bonds help win the war, and close the inflationary gap. They keep on working when victory comes . . . build an invaluable reservoir of purchasing power to help American business re-establish itself. You help your nation, you help your workers, and you also help yourself. Get started today!

You've done your bit — Now do your best!

THIS SPACE IS A CONTRIBUTION TO AMERICA'S ALL-OUT WAR EFFORT BY

Staff of The Tool & Die Journal

Ohio Revolving Round Table
Complete Self-Contained Unit



ENGINEERS of The Ohio Machine Tool Co. have applied over fifty years of experience in designing machine tools, to the development of a revolving table for which they promise long and uninterrupted service.

A high grade precision machine, this Round Revolving Table is accurately graduated in ½ degrees. Mounted on a base plate, it is a complete, self-contained unit, with an overall height of 7".

The large diameter king pin, clamp block and index bracket are all mounted on the base plate. The table has four index pin positions. It is carefully honed to a close fit with the king pin.

The tee slots, carefully machined from the solid, are of sufficient size and number for locating and holding fixtures and to thoroughly secure jobs directly to the table. A center depression in the table aids in conveniently locating fixtures, etc.

By a single motion of a lever, the table top can be raised completely from its bearing and supported by large anti-friction bearings. This device makes for easy and rapid revolving.

The model pictured here has a 30" diameter. The 24" and 36" tables, however, are similar.

For further information on this and other types of Ohio Revolving Tables, write The Ohio Machine Tool Co., Dept. R, Kenton, O.

Revco

INDUSTRIAL REFRIGERATION

REVCO Engineers have pioneered and produced the finest both in custom and standard lines of refrigeration equipment for industrial use.

SUB ZERO CHESTS

Features of compactness, sturdiness and precision are built into this unit. Adaptable to a wide varitey of uses. Temperature to -75° F.

RIVET DISPENSERS

Automatic,—selective for refrigerated aircraft rivets. Make possible mass production rivet handling. Write for full details.

REVCO, INC., Deerfield, Michigan

"Turn to Turchan"

. . . FOR FASTER PRODUCTION

. . . FOR BETTER WORKMANSHIP

. . . FOR FEWER REJECTS

DAY AFTER DAY, as America's mighty array of machine tools pour forth the things destined to keep men free, more and more Turchan Followers are becoming main-stays of industry.

Day after day more and more production men, harassed by high-pressure schedules, new machining jobs and inexperienced workers, see fit to *Turn to Turchan* the all-hydraulic duplicator, for solution of their troubles. You, too, can *Turn to Turchan* and save time, money and reject worries.

Turchan Followers attach easily to any standard lathe, planer, shaper, grinder or mill. They make it possible for any comparatively inexperienced operator to perform any machining operation any lathe, planer, shaper, grinder or mill can perform. Furthermore, he will do it better, faster and more economically.*

Turchan Followers are not costly machine tools. Rather, they are relatively inexpensive attachments to machine tools. And, unlike any other duplicating device available today, they do not interfere with normal use of the machines to which they are attached. That's why we say: IT WILL PAY YOU TO *Turn to Turchan.*

*Let us prove this statement to you.

"Turn to Turchan"

TURCHAN FOLLOWER MACHINE CO.

Originators of Hydraulic Duplicating

8259 Livernois Avenue Detroit, Michigan

Protecting Beauty, Not Displaying It, Real Job

POINTING out that forgetting just once to adjust a face shield or neglecting to wear a protective hair net for one day may mean a lifetime eye, head or face injury, The Boyer-Campbell Co. states in a new bulletin on safety clothing that the factory is not the place for a woman to worry about her looks —except as a thing to be protected.

Besides such essential articles as face shields, hair nets and respirators, today's women workers at machines have available other devices to guard their beauty. Protective hand creams are useful in preventing skin diseases when gloves cannot be worn. Plygarb sleeves protect their wearers from oil, water, acid and fire. Blue denim sleeves do the same thing for dust.

Other safety apparatus includes leather skull caps for protection of the hair, one and two-fingered gloves and welding goggles. Protective hair coverings—"musts" in factories today—range from snood-type hair nets to wrap around turbans.

In the picture above the girls are wearing B & C clear-face shields, blue denim sleeves, cotton gloves, duck slit aprons and hair nets. The girl on the right has the wrap-around type of head covering.

A catalog describing all this safety material for women will be sent upon request by the Boyer-Campbell Co., 6544 Antoine, Detroit, Mich.

SCIENCE *will win the* **WAR!**

Our Services

Flame Hardening · Annealing · Aerocasing · Bar Stock Treating and Straightening · Heat Treating · Pack or Gas Carburizing · Sand Blasting · Chapmanizing · Tempering · Cyaniding · Nitriding · Hi-Speed Hardening

METAL TREATING INSTITUTE

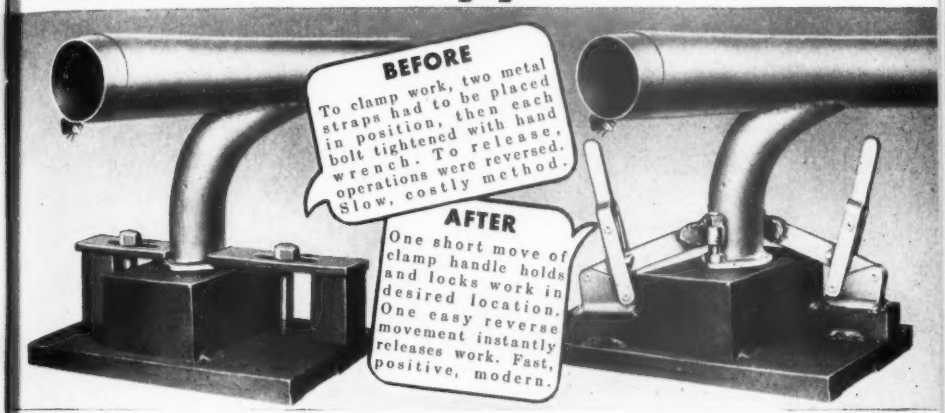
THE LAKESIDE STEEL IMPROVEMENT CO.

5418 Lakeside Avenue CLEVELAND, OHIO Phone Henderson 9100

Production Increased over 350%

thru use of simple fixture equipped with

DE-STA-CO *Toggle* CLAMPS


BEFORE
To clamp work, two metal straps had to be placed in position, then each bolt tightened with hand wrench. To release, operations were reversed. Slow, costly method.
AFTER
One short move of clamp handle holds and locks work in desired location. One easy reverse movement instantly releases work. Fast, positive, modern.

This fixture built only for checking flatness of flange and parallelism of tube, yet since 100% inspection was required a low cost fixture was needed, and De-Sta-Co Toggle Clamps again filled the bill.

The advantage of using De-Sta-Co Clamps lies in your ability to build a simple or more complicated fixture for purposes of increasing production, for less cost and in shorter time. Also by use of a confining nest for piloting, the clamp will not close unless the part is in proper location, which prevents errors due to stray or interfering chips.

De-Sta-Co Toggle Clamps Bulletin No. 43, just off the press, illustrates many different types of fixtures, some of which may suggest to you how the part you need to clamp can best be held.

Send for your copy of "Bulletin No. 43"—it's free.

Below are illustrated but a few of the many models available.

No. 215
Horizontal Style
Light Duty

No. 220
Light Weight
Popular Model

No. 210
Straight Bar
Medium Heavy

No. 250
Heavy Duty

No. 110-CO
Heavy Duty
Low, Straight Bar

★ ★ ★ ★ **DETROIT STAMPING CO.** ★ ★ ★ ★

Established Over 25 Years

344 Midland Ave • Detroit, Mich.

New Ammco Precision Shaper Easily Moved From Job To Job

MOUNTED on a portable cabinet, the 7" precision shaper just introduced by Automatic Maintenance Machinery Co. is designed to save time and steps in the tool and die shop. The worker can simply pull it up to his work bench, plug in and go to work. With it, there is no longer any need of operating the big shaper in the shop for small jobs.

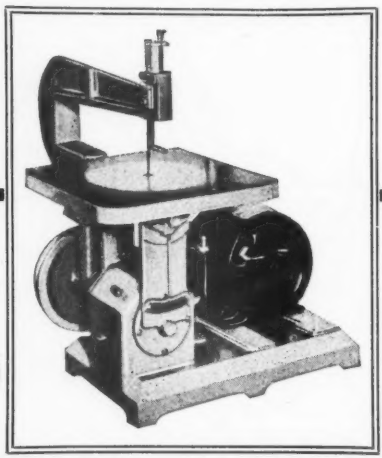
An aid in speeding production are the features of quick stroke adjustment, feeds, ram position, tool head, speeds, table height and table support. The tool head is graduated to 90° for angle work. The feed mechanism is reversible, with feeds varying from .003" to .018".

The semisteel vise, mounted on the table with a single bolt, is held in position with a key. The vise base is also graduated for any angle to 90° on either side of center and is provided with slats for three working positions of the table. The vise jaws have steel insert plates.

The countershaft has a four-step Vee pulley with separate adjustment for Vee belt and motor belt. For quick change of the belt, both pulleys and belt are enclosed behind a hinge-type safety guard.

The ways of the ram, tool head and front face of the main frame are all of the Vee type.

For complete details, prices and descriptive literature, address the Automotive Maintenance Machy. Co., 2122 Commonwealth Ave., North Chicago, Ill.



Price, complete with motor— $125 Net

F.O.B. Chicago

IMMEDIATE DELIVERY—Atlas Die Filing Machines

Can be used for all kinds of die making. The overarm is constructed so that the file and saw attachments may be interchanged with little effort. The holddown fingers are attached directly to the overarm. Working surface of the table, which tilts two directions, is entirely clear. An improved type of chuck, consisting of movable hardened jaws, holds both saws and files. Screw adjustment makes changes easy and fast.

ATLAS EQUIPMENT CO.

101 S. Clinton St. Chicago, Ill.

Detroit Distributor—International Machinery Co.
3131 E. Jefferson Ave. Detroit, Mich.

THE HEINRICH Handnib

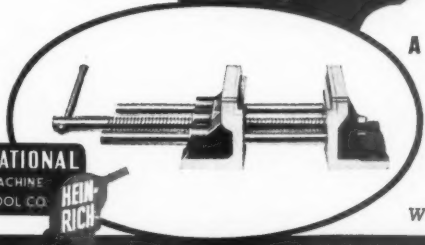
A tool for shearing, nibbling and rod cutting.

Cuts irregular sheet metal shapes quicker and better.

Capacity 3/16" flat stock—3/16, 1/4, 5/16 and 3/8" round stock.

An ideal machine for Toolrooms, Machine Shops — also for Pattern or Experimental Work.

Prompt Delivery



NATIONAL MACHINE TOOL CO. HEINRICH

A HANDY DRILL PRESS VISE

Built-in Parallels

No interference from Chips or burrs

Use it on three sides

Special V-Groove for round shafts

Through Drilling without damage to the Vise

WRITE FOR DESCRIPTIVE FOLDERS

THE NATIONAL MACHINE TOOL CO.

1536 CLARK ST., RACINE, WISCONSIN

CECO Introduces New Swiss Type Automatic Screw Machine

THE Swiss type Automatic Screw Machine, manufactured by The City Engineering Co., which incorporates the fundamental principles of the famous Swiss Automatic Screw Machine, is engineered to produce extremely accurate parts at high speed.

The CECO differs from the conventional automatic screw machine in not using indexing turrets, box tools nor form tools. In their place, four simple, inexpensive tool bits are used. These turn and face the work as the revolving bar stock is being fed forward through the work guide bushing, just back of the bits. The guide bushing serves much the same as a steady rest on a tool room engine lathe, assuring concentricity.

The bits are advanced radially to do their work and are receded when not in use. They can be easily ground or resharpened on a regular stand grinder by the average shop mechanic or set-up man.

Double micrometer adjustments maintain accuracy of diameter and lengths of shoulders. Merely by generating the flat cams mounted on the camshafts, odd shapes, complicated forms and tapers can be produced. Attachments mounted on the end of the machine will perform drilling, reaming, counterboring, tapping, threading and similar operations.

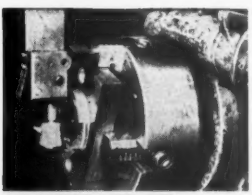
For further information, write The City Engineering Co., Dept. E, Dayton, O.

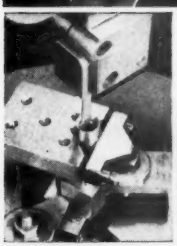
4 of the many ways . . .
SLOTMASTER *can be used to save* TOOLS & SET-UPS

Left: Set-up for lapping deep impression die.

Below: Set-up for cutting an internal gear.

SLOTMASTER can be used on any round or flat-on-round over-arm milling machine and will do precision work that normally requires a multi-thousand dollar machine (all of the working parts are of tool steel, heat treated). It takes but little time to change over from one head to the other . . . the stroke of the ram is adjustable from 0 to 4" . . . the speeds range from 50 to 250 s.p.m. The tool holder is of the clapper box type and can be turned in any position . . . SLOTMASTER comes complete with pulleys, motor, mounting bracket, etc. . . . *Send for 4-page catalog—give specifications of the milling machines you wish to equip. Immediate deliveries on high priorities.*



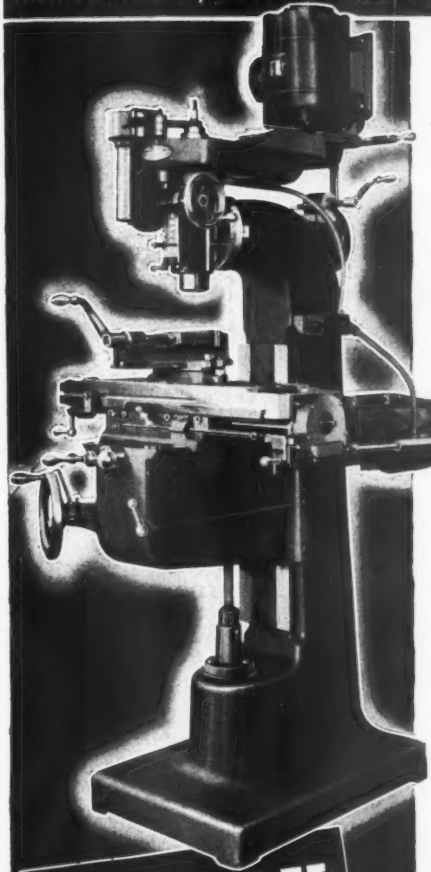


EXPERIMENTAL TOOL & DIE COMPANY
12609 Greiner
Detroit, Mich.

Below: Conventional set-up on a round over-arm milling machine; thumbnail shows set-up for cutting a spline.

INDEX MILLS

Manufactured by Index Machine and Tool Co., Jackson, Mich.



CHECK THESE FEATURES!

★ Precision Ball Bearing Spindle that will require no attention for two years.

★ Swivel Head which can be set 90° right or left.

★ Super construction sensitive enough to do work with end mills 1/8" diameter yet rugged enough to use 3/4" end mills taking full cuts 24 hours a day.

★ Verniers for locating, and power feed to spindle for boring.

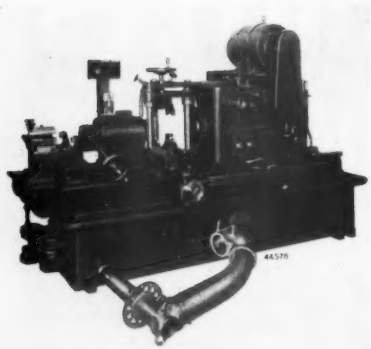
★ A versatile machine that can be used in the tool room or on the production line.

Send inquiries for immediate quotation and quick delivery to Factory Sales and Distributing Agents.

BLANK and BUXTON MACHINERY

3100 E. MICHIGAN AVE.
JACKSON, MICHIGAN

Snyder Single Spindle Hydraulic Boring and Facing Machine



AIRCRAFT manufacturers who have had difficulty in accurately boring and facing parts that have a tendency to vary slightly in length will find this new Snyder Single Spindle Hydraulic Boring and Facing Machine helpful in meeting their problems.

Tooling consists of a breech lock spindle adaptor and various boring, facing and undercutting tools. A revolving dog rail, which can be quickly set up for each tool, controls the distances which the various tools feed through the workpiece. The spindle returns to position after each work cycle, enabling the operator to quickly exchange tools.

The work holding fixture is manually operated. The part is located and clamped against two ground diameters on a shaft exactly at right angles to the boss that is to be bored. The variation in part lengths is taken care of by providing a part length indicator on the fixture and then compensating for it by moving the solid stops on the spindle unit. This compensation is achieved by setting the second indicator, located about the chip chute at the front of the fixture, at a reading corresponding to that of the part length indicator. Final clamping of the hub to be bored and faced is done through equalizing Vee jaws.

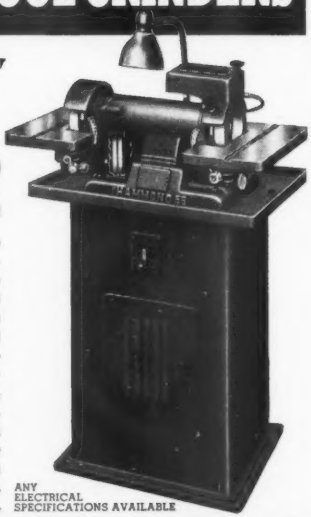
For complete details write The Snyder Tool and Engineering Corp., Dept. K, 3400 East Lafayette St., Detroit, Mich.

Hammond

CARBIDE TOOL GRINDERS

NEW 6"

BELTED MODEL



For fast and accurate silicon carbide or diamond wheel grinding the new Hammond Model 6-B Carbide Tool Grinder is multi V-belt driven. V-belt drive plus precision spindle dampens motor vibration and provides true, smooth running wheels. Wheels wear longer and grind faster because the Hammond 6-B gives you velvet-smooth operation. Write for Bulletin No. 202.

ANY ELECTRICAL SPECIFICATIONS AVAILABLE

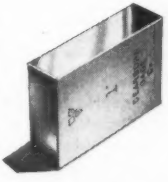
Hammond Machinery Builders INC.

KALAMAZOO, MICHIGAN

1631 DOUGLAS AVENUE

EASTERN BRANCH - 71 WEST 23rd STREET, NEW YORK, N. Y.

Make sure he gets it by using the *finest* standards available . . .



Today, manufacturers are working to closer tolerances on production lines, to meet the exacting specifications of our Army and Navy. It is, therefore, important that they have the *best* checking gages and instruments to meet these tolerances. This is the reason why the Dearborn Gage Company's Chromium Plated Gage Blocks are preferred by manufacturers who recognize their superior accuracies and longer wearing qualities. Yes, Dearborn gages cost more, because they are worth more to the manufacturer.

For complete information about these chromium plated gage blocks write or wire us today.

DEARBORN GAGE CO. 22034 BEECH STREET DETROIT, MICHIGAN

Originators of Chromium Plated Gage Blocks

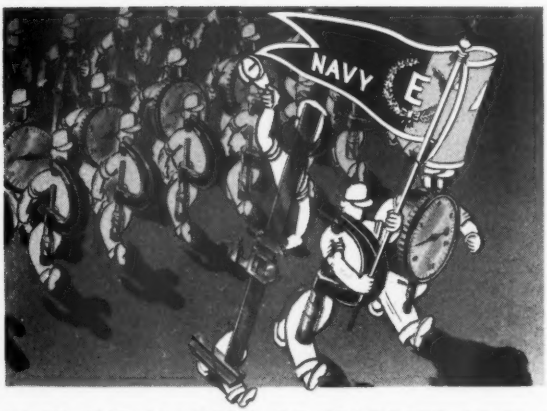
New Prosser Grinder Is Versatile, Accurate

MODEL AA Floor Type Carbide Grinder, newest product of Thomas Prosser & Son, provides for rapid removal of metal when roughing, together with the most accurate finishing of all single-point tools to smooth, keen cutting edges with flat surfaces, held exactly to the desired angles. Either silicon carbide or diamond wheels for grinding carbide or aluminum oxide wheels for grinding stellite or high speed steel can be used.

Improvements included on this model are a new heavy base, drum type on-off reverse switch, heavier tables and storage compartment for wheels and tools. In addition this model incorporates all the features of the regular Prosser grinders, including the simple, positive quick-acting indexing device permitting instant setting of the table to the desired angle and eliminating all unnecessary loss of time and motion. The table "stays put" at the angle to which it is set.

Oversize 7" wheels on this model give longer wheel life and permit the grinding of larger tools than the usual 6" wheel. Location of the hubs on the shaft is easily adjustable to compensate for wheel wear. The face of the wheel can be kept close to the edge of the table and the wheels can be used up practically 100%, giving maximum economy.

Thomas Prosser & Son, Dept. T-J, 120 Wall St., New York, N. Y., will be glad to furnish more complete information.



NOW THE MAKERS OF STARRETT TOOLS GET THEIR "E" BADGES

It is fitting that the craftsmen and women who have contributed their utmost skill and energy to the fashioning of unprecedented numbers of precision tools now wear this badge of honor. Grateful acknowledgment is also due our suppliers and the distributors of Starrett Tools for doing so much to help us attain this honor.

STARRETT TOOLS are lending accuracy and speed and confidence to hundreds of thousands of willing and devoted hands helping to win this war of precision machines and equipment. We shall keep on doing our level best to produce an adequate supply of the tools worthy of this great responsibility.

THE L. S. STARRETT CO., Athol, Massachusetts, U. S. A.
World's Greatest Toolmakers

SHOP AIDS

DOALL CONTOUR SAWS—free 265-page textbook of importance to the industry using contour sawing and filing equipment. It covers the latest techniques for contour machining: internal and external three dimensional parts for "short run" forgings, multiple identical parts in one operation for "short run" stampings, and facilities for handling both massive and small jobs as reported from the field.

The book includes specific information on machine tools and machine shop practice for the student, and a discussion on methods used to find the best type of saw, saw velocity and feed pressure for cutting materials most economically. Charts and diagrams show proper speeds and feeds in the shaping of all basic materials.

Liberally illustrated, this textbook is shop coat pocket size, with a bound blue embossed cover to resist smudging and wear from hard usage. It is now being distributed free by the DoAll Service Office, 1210 Thacker Street, Des Plaines, Ill., to industry, training schools and libraries.

A COURSE IN POWDER METALLURGY—an excellent survey of a new field for anyone alert to the implications for the future in this important phase of metallurgy. The significance of powder metallurgy lies in the ability of this technique to produce complicated metal shapes within a close limit of tolerance by a process requiring less time and skill than machining, and lower temperatures and fewer finishing operations than casting.

As such, the relation to an accelerated war production program is obvious and makes the need for a book on the subject particularly urgent at this time. This volume by Walter J. Baeza includes chapters on the history of the science, production of metal powders, powder specifications, classification of particle size and cohesion.

There is a special section on the problems of teaching the course plus a chapter of instruction to students. In addition there are very valuable detailed write-ups of fifteen important experiments. Price $3.50 from McGraw-Hill Book Co., Inc.

THE MACHINE TOOL PRIMER—is exactly what its name implies—a first reader on machine tools. It explains simply and directly what the metal working industry is all about. It paints a broad word picture of how metal products are manufactured and as such is excellent introductory material for the student and the shop neophyte.

The volume is divided into two distinct parts —Book I reviewing the whole problem of the metal working industry in general terms while Book II takes up in detail the five basic machine tool operations. Although highly simplified, the book is nevertheless sufficiently technical and concrete to provide a working background of the subject. Written and published by the Herbert D. Hall Foundation, 1060 Broad St., Newark, N. J.

FUNDAMENTALS OF MACHINES—Following a War Department outline, this textbook and its accompanying workbook includes the information necessary to the mastery of certain operation skills essential for twenty-five or more Army occupations. Especially written for men preparing for war service, the purpose of the book is not to train men in skills pertaining to machines, but rather to instruct them in the fundamental principles of physical science. With a mastery of this background information, the prospective Army man has the opportunity of becoming a better mechanic in a much shorter time.

The book is prepared in a style designed to make both the learning and teaching of the subject as easy and as rapid a process as possible. One of a Preinduction Training Series put out by the American Technical Society, Chicago, Ill., it is written by Glenn M. Hobbs, Ph.D., L. H. Morrison, B.S. in M.E., and Ray F. Kuns. Price $2.00.

FUNDAMENTAL SHOP TRAINING—another in the American Technical Society's popular Preinduction Training Series, prepared for men about to enter war service. This textbook and its accompanying workbook comprise a course planned to provide thorough and careful instruction in fundamental shop skills and techniques, to develop manipulative skills, and to impart a knowledge of the qualities and characteristics of materials, and of construction processes and procedures.

Like others in the series, this book follows a recommended War Department outline. Its presentation is simple and direct, specially adapted to the novice. John T. Shuman, Capt. Bailey Wright and James Ritchey are the authors. Price $2.00.

TWO SPINDLE
Adjustable
DRILL HEADS
Drill Two Holes At Once

✓ *Adjustable Centers from ½" to 6"*
✓ *Drill Capacity 0 to 5/8"*

Sleeve and overarm types . . . in several sizes. Will double output of any single spindle drill press.

Quickly adjusted to desired drill centers from ½" to 6".

Send for bulletin.

LINDERME MACHINE & TOOL CO., INC.
12250 COYLE AVE., DETROIT, MICH.

SCREW THREAD MANUAL—a highly technical treatment written for those actually engaged in screw thread production, for designers, draftsmen, foremen and executives. The author covers fully the photometric systems of measurement and the processes of thread milling and thread grinding. He discusses the details of screw-thread production in the lathe, by means of collapsible die heads and taps, by rolling and other processes.

The screw-thread standards in common use with tables of their proportions in the various sizes are included. There is also a chapter on modern methods of nut and bolt production. By F. J. Camm. Price $2.75 from the Chemical Publishing Co., Inc., Brooklyn, N. Y.

MANUAL OF METAL CUTTING INFORMATION—Here is a handy pocket-size booklet you can hang in the shop for the ready reference of any worker. It covers the correct use of hand operated hack saws, recommended teeth and speeds for cutting various metals

with hand blades and with power blades, tips on power hacksaw operation, and a listing of probable causes of difficulty in metal cutting operations. The pamphlet is yours for writing to W. O. Barnes Co., Inc., Dept. XY, Detroit, Michigan.

WOMEN IN PRODUCTION WORK—W. E. Whipp, the president of The Monarch Machine Tool Co., recounts the experience of his company in employing women. Other companies, particularly in the machine tool industry, will find his suggestions and observations of help in making their transition from employing men to women. The 8-page booklet is yours by writing to The Monarch Machine Tool Co., Dept. D. Sidney, Ohio.

NEWEST TOMAHAWK POSTER—released by Genesee Tool Co. depicts a bullet and a broken cutter with the wording: "This bullet could stop a Zero—This tool could produce enough equipment to stop a hundred Zeros." It emphasizes the fact that every broken tool means an equivalent delay somewhere in securing tools for production of war goods. For your copy write to Genesee Tool Co., Dept. TD, Fenton, Mich.

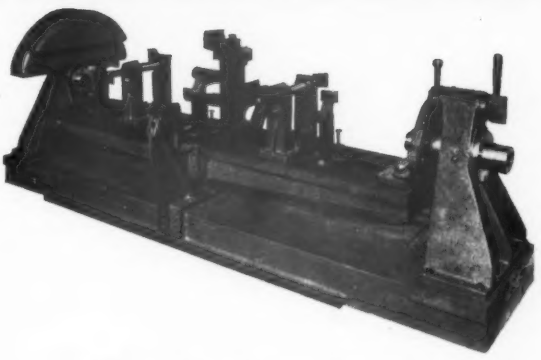
CARBURIZING GEARS IN THE ELECTRIC SALT BATH FURNACES—a scholarly and highly technical treatment of the subject by Metallurgist William F. Sorenson. The paper deals with the problem of metallurgical *control* coordinated with increased production in the heat treatment of oil hardened gears and axles, as well as carburized gears and parts. Copies are available from the Ajax Electric Co., Inc., Dept. NK, Frankford Ave. at Delaware Ave., Philadelphia, Pa.

DIMENSIONAL CONTROL—portfolio of forty large 27½" x 32" class room charts prepared by The Sheffield Corp. The charts (a revised edition of a set distributed some months ago) give basic definitions of such terms as limits, allowance, tolerance, clearance and interference; the principles of GO and NOT GO gages, wear allowance, gagemakers' tolerances and gaging policy. Tables of fits and tolerances are included. Price $3.50 to schools, colleges and industry training classes from the Sheffield Corporation, 730 Springfield St., Dayton, O.

TWO APPRENTICE TRAINING PAMPHLETS—issued by the War Manpower Commission—are available through any regional office or the Washington office of the Apprentice

(Continued on Page 172)

We Sell Precision . .



★ Dies, Jigs, Fixtures, Special Machinery and Designing.

Hardened and Ground Parts to Order.

MASTER MACHINE & TOOL COMPANY

925 WEST NORTH AVENUE, CHICAGO, ILL.

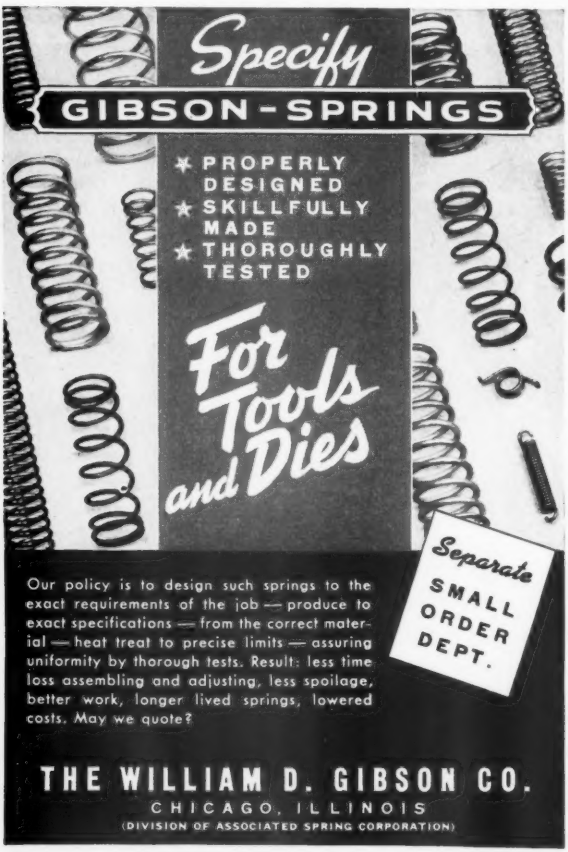
(Continued from Page 171)

Training Service of WMC. "Apprentice Training for Youth" stresses the training of 16 and 17-year-olds, while "The National Apprenticeship Program" gives a general outline of WMC's apprentice training program.

AMERICAN ELECTRICAL STANDARDS FOR FRACTIONAL HORSEPOWER MOTORS—clear, concise definitions of standard motor and machine parts, types and classifications compiled by The Dumore Co. Write to Dept. K, Racine, Wis.

MOTION STUDY FOR THE SUPERVISOR—clearly recognizes the importance of the man in the shop's cooperation in any successful motion study program. Once he comprehends, through a sound understanding of basic motion-study principles, what constitutes good or bad practice, he can be of invaluable help to a competent motion study analyst. By giving the supervisor a practical explanation of the subject in his own language, the book enables him to view motion study as an important tool in improving his operations.

A simplified new method of observing time and motion consumed in a job is thoroughly outlined by the author. Based on common-sense rules and principles, the new method points out the ineffective work in the operation and at the same time indicates the cause and the correct means of removing that cause. Written by Norman R. Bailey, Wage Standards Engineer for Eastman Kodak Co. Price $1.25.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GIBSON-SPRINGS
★ PROPERLY DESIGNED
★ SKILLFULLY MADE
★ THOROUGHLY TESTED
For Tools and Dies
Separate SMALL ORDER DEPT.
Our policy is to design such springs to the exact requirements of the job — produce to exact specifications — from the correct material — heat treat to precise limits — assuring uniformity by thorough tests. Result: less time loss assembling and adjusting, less spoilage, better work, longer lived springs, lowered costs. May we quote?
THE WILLIAM D. GIBSON CO.
CHICAGO, ILLINOIS
(DIVISION OF ASSOCIATED SPRING CORPORATION)

PLASTICS FOR INDUSTRIAL USE—an "Engineering Handbook of Materials and Methods." As its subtitle suggests, the book is a study and discussion of plastics as engineering materials. The new trend in the use of plastics, developed and intensified by the war, makes this treatment of the subject extremely timely. More and more engineers are now investigating plastics as engineering materials — not merely as alternates but as replacements with certain inherent characteristics and advantages that can be capitalized on in new engineering designs.

The author devotes several chapters to comparative properties of plastics, molding methods, engineering and finishing. These are followed by a detailed discussion of specific materials which have been found particularly suitable for industrial products. By John Sasso; published by McGraw-Hill Book Co., Inc. Price $2.50.

Swivelier Work-Lites Give Directive Lighting on the Job

TODAY'S concentration on close tolerance and assembly work demands a lighting efficiency impossible to achieve with general overhead lights. The plea of workers for directive lighting attached to the machine tool is answered by the Reliance Devices Co., manufacturers of "Swivelier" machine-light units.

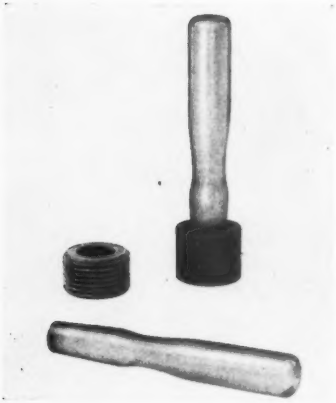
Unaffected by machine vibration, the "Swivelier" Work-Lites will stay put at any angle. Because of a patented spring construction in the Swivel base and Swivel socket, the light cannot work loose or drop down. The socket adjusts to a full 90° vertical range and rotates 350° horizontally. The arm in the base also has the 90° vertical adjustment and 350° horizontal range.

With no set screws or wing nuts to adjust, the "Swivelier" puts the light on the spot where needed. Remarkably adaptable to all situations, the Work-Lites are available in a choice of arm lengths, in three types of shades (attached to the unothread socket) and with a switchless base and key socket or with a switch in the base and a keyless socket. Wire is completely enclosed in the oil and dust resistant unit.

"Swivelier" Work-Lite units can be attached to machines, walls, ceilings, work benches, drafting boards, assembly tables, etc.

"Swivelier" catalogs are available on request. Write to Reliance Devices Co., Inc., Dept. TDJ, 510 Sixth Ave., New York. N. Y.

FLATNESS and SMOOTHNESS
of Production Parts
The Ultra-Lap machine will finish your parts to a flatness of one light band or less . . . to a smoothness as low as one micro-inch R.M.S., any metal or material. Much faster, more uniform than hand method. Machine designed for you or we shall be pleased to lap your parts on a job basis. Ultra-Lap machines and service used by aircraft and many other war-time industries.
Ultra-Lap MACHINE COMPANY
245 McDOUGALL AVE. · DETROIT, MICH.



Plastics Handled Gage Ready for Manufacture

A NEW plug gage with interchangeable handle of plastic, developed by the White Machine Works, promises to cause as much commotion as the recently adopted glass gages. Use of the plastic handle saves almost the same amount of critical material as with glass, and in addition it is also possible to make thread gages with this plan.

While most gages are made of solid steel (the handle being a part of the gage), this new gage cuts the weight of a plug gage to one-third, saving two-thirds of the steel formerly necessary and reducing fatigue of the user.

The metal part of the gage is a simple turning, plain or threaded, which can be produced in quantity on a lathe, hardened, and ground to exact size. It is hollow and the inside has a standard Morse taper which grips a plastic handle when it is inserted.

The handle itself, being plastic, has no thermal conductivity and cannot transfer body heat to the gage. It may be used interchangeably in several different gages and can be used over again even after the metal part of the gage is so worn that it requires replating and regrinding.

Though White Machine Works will not manufacture these gages or handles, it has made patent application on them and will authorize the use of the idea to industry by contractual arrangement.

Inquiries should be addressed to White Machine Works, Fort Wayne, Ind.

HOLLAND MILLER
With
SWIVEL HEAD

This rigid and versatile miller answers the need for a flexible toolroom and production machine with an unusually wide range of speeds. Note these exclusive features:

- Controls of table and head are all reached conveniently from the operator's seat.
- Rigid table mounting at permanent height provides extra stability and accuracy.
- Swivel Head, with motor centered above spindle, has 8" travel and 3" quill feed.
- A wide range of speeds, 200-4375 RPM, with standard motor, or 1/3 less with slow speed motor, is offered for boring and high-speed milling.

Write TODAY for complete specifications and descriptive details.

IMMEDIATE DELIVERY

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88-92 West St. New York

PUBLICATION PREVIEWS

Sales and Technical Literature

Send Request on Company Letterhead

HPM METAL WORKING PRESSES—are illustrated and minutely discussed in Bulletin 4206 of The Hydraulic Press Mfg. Co., Dept. H, Mt. Gilead, O. Sketches of punches, dies, die cushion platens, etc., are included for regular deep drawing presses, rubber pad forming presses and presses for forging, die straightening, coining, and other diversified production.

AUTOMATIC RISE & FALL MILLING MACHINES — Latest engineering specifications on the No. 2-24 Automatic Rise and Fall Milling Machines of the Cincinnati Milling & Grinding Machines, Inc., are included in a new catalog just issued. Well illustrated, the catalog completely describes this model and diagrams its working parts. Inquiries should be addressed to the company at Dept. A-1, Cincinnati, Ohio.

BILGRAM BEVEL GEAR GENERATORS—and chamfering machines are the subject of a catalog issued by Bilgram Gear & Machine Works, 1223 Spring Garden St., Philadelphia, Pa. Included are 6", 8" and 16" automatic Bevel Gear Generators and 12" Bevel Pinion Generators.

TUTHILL PUMPS—used for such diversified jobs as circulating cooling solution through large X-ray tubes and lifting heavy generator shafts are discussed in a catalog, "Pumps for the Purpose," issued by Dept. H, Tuthill Pump Co., 939 E. 95th St., Chicago, Ill. Besides these small industrial pumps, general purpose pumps, viscous liquid pumps, high-pressure pumps, coolant pumps, automatic reversing pumps, and stripped pumps are also discussed.

FLOATING TOOL HOLDERS—which automatically put the machine spindle or screw machine turret into perfect alignment with the work are described in several leaflets of the W. M. Ziegler Tool Co., 1920 12th St., Detroit, Mich. Such holders are useful on new machine tools to compensate for spindle mis-alignment, as well as on machines with spindles which have become worn through service.

WATER-WASH SPRAY BOOTHS — developed to meet high-speed industrial spraying requirements are illustrated and described by Aqua-Restor Division, Mayer Mfg. Corp., Dept. T-J, 50 Division Pl., Brooklyn, N. Y., in a new bulletin. Water curtains which are continuous and completely controlled offer maximum spray painting production without "showering" the worker.

VERSATILITY PLUS—is possible with the No. 4 Greenfield Tool & Cutter Grinder and its varied attachments. Bulletin No. 2 published by Dept. A-2, Production Machine Co., Greenfield, Mass., states that there is hardly a grinding operation that cannot be handled within the machine's capacity.

DOUGLAS MACHINERY CO.'S—new 16-page bulletin describes the design features of the Rotorex No. 1 Grinder, illustrates and lists standard equipment and the universal workhead with power attachment. Other extras include attachments for cylindrical and internal grinding, tap and radius grinding and draw-in collet attachment.

"THE PEAK OF PERFECTION IN LATHES"—is the description given their engine lathes by Apex Machine Tool Co., 384 Fourth St., San Francisco, Calif., in a new bulletin.

(Continued from Page 175)

A cross section diagram, a table of specifications and many photographs make the information very complete.

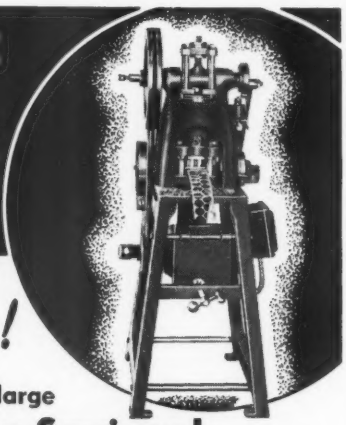
GLOBE MILLER—Use of the Globe Miller on lathes converts them to milling operation in three minutes according to a new bulletin of Globe Products Mfg. Co., 3384 Robertson Blvd., Los Angeles, Calif. With this attachment any lathe can do plain and angular milling, slotting, slitting, keyway cutting, dovetailing, spur gear cutting, rack cutting and many other types of work.

HOW TO MAKE YOUR OWN MACHINE TOOLS—is described in Catalog No. 43 of Dept. T-J, Lewis Machine Tool Co., 3017 N. Main St., P. O. Box 116, Los Angeles, Calif. Lewis Machine Tools are complete sets of well designed, high quality rough or semi-finished castings with engineered blueprints for 23 practical units. They can be completed by home craftsmen, training schools and machine shops who wish to use them for manufacturing purposes.

TAPS, GAGES, THREAD HOBS—are all covered in Detroit Tap & Tool Co.'s Catalog No. 22. Spirally bound and specially indexed, the book is a complete reference unit for this company's tools. Request should be addressed to the company at 8432 Butler St., Detroit, Mich.

SPARK PLUG BUSHINGS—Bulletin No. 237 of the Aircraft Screw Products Co., Inc., gives the specifications of this firm's "Heli-Coil" Spark Plug Bushing. This bushing is a variation of the "Aero-Thread" Screw Thread System which is widely used to strengthen and reduce wear in threaded fastenings. Requests should be addressed to the company at 46-22 35th St., Long Island City, N. Y.

PUNCH SMALL STAMPINGS ON A SMALL PRESS



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You waste precious time, run up excessive power and labor costs, and lose vital man-hours when you use small dies on a big press. The Diebel Hi-Speed Press is compact, operated by women or unskilled men workers, punches out as many as 550 pieces a minute, uses little power, small floor space. The Diebel Press is in tune with the times.

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"HOW TO GAUGE MACHINE & TOOL EXPENDITURES"—is a valuable little booklet issued by Al J. Conn, managing director of LaSalle Designing Co., Dept. T-J, 628 W. Lake St., Chicago, Ill. "Every firm always pays for good engineering — either on the drawing board or in excessive production costs," Conn says and points out that a job may call for re-engineering rather than re-tooling, that relative tooling and labor costs should be compared before deciding which is to get the production break.

NEW INDEX MILL—A new index mill with heavier table, saddle, knee and column, capable of high speed milling, drilling and boring, is described in a Blank and Buxton Machinery Co. folder. Full specifications can be obtained by writing the company at 3110 E. Michigan Ave., Jackson, Mich.

SPECIFICATION SHEET—The No. 0-9 Vertical Milling Machine & Jig Borer of the Industrial Tool & Die Works, Inc.., Dept. T-J, Minneapolis, Minn., is of fixed bed type construction with spindle speeds ranging from 300 to 3800. Head swivel is 180 degrees. All rotating parts, gears and sheaves are enclosed. More details are available in this folder from the company.

NECESSITY OF INSPECTON—of machine tools before errors affect production, even in smaller shops, is stressed in a bulletin of the Geo. Scherr Co. which deals with the Scherr limited budget inspection laboratory. Basic inspection tools are illustrated and their usefulness outlined. Inquiries should be addressed to the company at 128-B Lafayette St., New York, N. Y.

LATHE STOP GAGE—Lathes are made semi-automatic, accidents and spoiled work prevented and production increased with their Model 2 automatic lathe stop gage, according to The American Products Co., 2285 Hollers Ave., Bronx, New York, N. Y. The operator may set up a cut taking 15 or 30 minutes and then turn to some other work. When more than one tool is used, separate stops can be set on the gage for each cut. A bulletin is available from the company.

TWISTITE PRESSURE UNITS—and C-Clamps are advanced by their manufacturer as a means of eliminating slow, full-threaded clamping tools. They employ a push-pull design that sets the pressure bar in any position from full open to full closed in an instant. Michigan Clamp Co., Dept. H, Jackson, Mich., will send Bulletin No. 43.

THOMAS MULTI-PURPOSE BARS—feature a quickly adjustable micrometer setting and a positive locking arrangement, both accessible to the operator at all times. This eliminates the inevitable loss of time and inaccuracy of the old conventional methods of tapping the tool bit in and out to the desired position. A folder put out by The Thomas Tool Co., Dept. T-J, P.O. Box 5069, Pittsburgh, Pa., will be sent by the manufacturer.

STEEL STAMPS—Marking and numbering equipment and stamping machines are described in detail in four bulletins of The Acromark Co., 5-15 Morrell St., Elizabeth, N. J. Information on embossing dies, roller die marking and other specialized equipment is included.

(Continued on Page 178)

DOUGLAS PRECISION SLOTTER
Swiveling ram head and tool holder, automatic circular table and independent automatic feeds in all directions.
7" TO 10" STROKE
DOUGLAS
PROMPT DELIVERY
DOUGLAS MACHINERY CO. INC.
150 BROADWAY
NEW YORK, N. Y.

(Continued from Page 177)

PUMP ENGINEERING MANUAL—A series of data sheets covering Pioneer and Rollway Pumps show the variety of applications possible and give interesting technical information on this brand of pumps. Pioneer Pump & Mfg. Co., 29 Melbourne Ave., Detroit, Mich., will send these leaflets for your pump engineering manual and other literature upon request.

RECO MOTOR DRIVEN CONTROLS—are illustrated and explained in Bulletin No. 71 of the Reynolds Electric Co., Dept. 4-G, W. Congress St., Chicago, Ill. Using the motto, "If it can be done manually, a Reco can do it automatically," the bulletin points out the variety of Reco control—capable of making and breaking circuits as fast as 5,000 times per hour and as slow as once every 24 hours or longer.

BLAST CLEANING AND DUST COLLECTING EQUIPMENT—are briefly covered in the Pangborn Corp.'s condensed catalog. Roto-blast units, tables and barrels, air blast machines, casting washers and blast cleaning accessories are included. This catalog and more detailed bulletins on each type of equipment are available from this manufacturer at Dept. T-J, Hagerstown, Md.

HARD-FACING WITH COAST METALS—is explained in a booklet of that name which should pay dividends to the producer who wants to cut wear and conserve critical metals. Examples of the effectiveness of this procedure are shown in relative wear of such equipment as hot clinker crusher rolls, hot shear knives, glass hammers, etc., when faced with Coast metal and when not. Requests for this booklet should be addressed to Coast Metals, Inc., 1229 Camden Ave., Canton, O.

ALL-WELDED—to withstand the most rigid specifications, the new Despatch high-temperature fan is also acid resistant and useful in chemical and metallurgical industries. Bulletin No. 78 has just been issued to outline full specifications and is available from Despatch Oven Co., Dept. H, Minneapolis, Minn.

CONTROLLED ATMOSPHERE FURNACES—Delaware Tool Steel Corp.'s new catalog on this equipment shows how this firm developed their present line of furnaces in answer to the need for completely uniform and automatic

Don't be "stumped" if the specifications call for

DRILLING HARDENED STEEL

● You can do it! HARDSTEEL Drills enable you to drill, counterbore or enlarge holes in hardened steel by the same methods you would use on soft steel, and *without annealing any portion of the piece.* A remarkable time-saver! Write for illustrated instruction booklet.

We can fill your requirements for Die Springs, Dowel Pins, Socket Screws and all other Die Makers' supplies.

DIE SUPPLY CO.

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4751 Hough Ave., CLEVELAND, O., EXpress 1133

heat-treating. Requests will be welcomed by the company at Dept. C, Wilmington, Del.

MOTCH & MERRYWEATHER MACHINERY'S—new bulletin on the triple-chip method demonstrates how this type of cold sawing is high in efficiency and lengthens blade life. Two teeth operate on a "Hi-Lo" principle, the first or higher tooth being the roughing tooth and the second, or finish tooth, being full width and slightly lower than its predecessor. Inquiries should be directed to the company at Dept. J, 715 Penton Bldg., Cleveland, O.

HACKSAW AND BANDSAW—users will be interested in the announcement by Die Supply Co., 4751 Hough Ave., Cleveland, O., that they have been appointed distributors of Sterling and Super-Sterling saws manufactured by Diamond Saw Works of Buffalo. Phone or mail orders can be *filled*, Die Supply says! A pamphlet describing Diamond saws more fully is available on request.

PLASTIC MODELS—are the subject of a broadside issued by Stricker-Brunhuber Corp., Dept. H, 19 W. 24th St., New York, N. Y. Why not try a plastic model before putting molded parts into production, it suggests. Opportunity with models to test for sales appeal, workability, dimensions, mechanical reactions, etc., is pointed out. Transparent models can be made also for manufacturers who want to check internal operations.

A NEW FACING MACHINE—just announced by Morey Machinery Co., Inc., 411 Broome St., New York, N. Y., is described in a broadside. Especially adapted to facing the end of long or irregular shaped pieces that would be difficult to mount on a planer, the machine is also very suitable for facing spots on large castings where, of necessity, the castings must be held stationary and the facing head brought to the spot which requires machining.

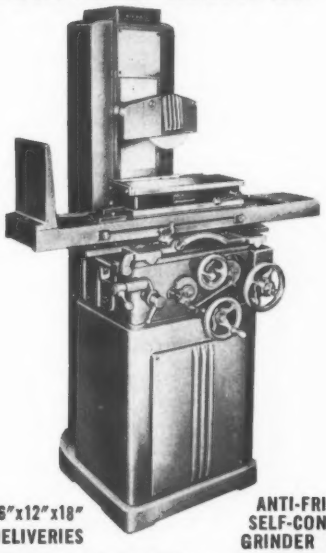
COLLET CLOSER—Recor Mfg. Corp., 433 S. Green St., Chicago, Ill., describes its lever collet closer in a broadside recently issued. It permits feeding and releasing of bar stock through the collet without stopping the lathe. Inquiries should contain specifications as to make of lathe, model number and spindle dimensions such as overall length, inside and outside diameters and outside diameter of spindle where change gears are or would be.

(Continued on Page 180)

ATLANTIC

No. 2 Automatic Precision

SURFACE GRINDER



CAPACITY 6"x12"x18"
PROMPT DELIVERIES

ANTI-FRICTION SELF-CONTAINED GRINDER SPINDLE

ATLANTIC MACHINERY CORP.

149 Broadway **New York, N. Y.**

(Continued from Page 179)

AIRCRAFT STEEL—Specifications for aircraft alloy steel are available to all buyers and technical men in the aircraft and aircraft parts manufacturing industries in a recent combined special stock list and data book published by Jos. T. Ryerson & Son, Inc. In addition to listings of available steels, the handbook furnishes a condensed version of all the Aeronautical Material Specifications (AMS) which pertain to steel. Inquiries should be addressed to the company at Dept. J, 16th & Rockwell Sts., Chicago, Ill.

VEELOS LINK V-BELTING—How to install adjustable belting on the machine drive is the subject of this new catalog of Manheim Mfg. & Belting Co., Dept. H-1, Manheim, Pa. Pictorial directions illustrate the installation steps and advantages of this belting which can be uncoupled from a roll and rejoined in any desirable length. Tables and HP ratings provide information on how to engineer a Veelos drive.

PRECISION MEASURING TOOLS—Microgages, light wave equipment and measuring wires are among the measuring tools discussed in The Van Keuren Co.'s Catalog No. 31. Laps, shop triangles and flats are also covered at the back of the catalog. Requests should be addressed to the company at 178 Waltham St., Watertown, Mass.

SCLEROSCOPE MEASURING—of the hardness of metals is taken up in great detail in the 12th edition of a small book issued by The Shore Instrument & Mfg. Co., 9025 Van Wyck Ave., Jamaica, N. Y. Eighty pages cover such subjects as carbon tool steels, hardness and cutting, the relation of hardness to other physical properties, etc. It is available from the company for 25c.

Maximum Tool Life
***plus* Maximum Production**
—Use CROBALT!

● A superior heat resisting chromium-cobalt-tungsten high speed cutting alloy. Permits higher speeds with longer tool life.

Eliminates the possibility of chipping. Combines maximum production with minimum cost per piece.

Catalog rushed on request . . .

Write Dept. F

CROBALT INC.
ANN ARBOR, MICHIGAN

CROBALT

HOT & COLD TEMPERATURE PROCESSING—is covered thoroughly in the new catalog of Kold-Hold Mfg. Co., 445 N. Grand Ave., Lansing, Mich. Pointing out that wartime production schedules have shown many plants the necessity for using high and subzero temperatures, Kold-Hold has compiled the data presented to show the facilities available for such processing.

WEST'S AUTOMATIC STOP—for commercial dies is explained and its operation and installation detailed in a broadside issued by R. C. West, Dept. T-J, 331 W. Hazeltine, Kenmore, N. Y. Request for copies should be addressed to the company.

UNIVERSAL'S 3-WAY ANGLE-SET VISE—makes it possible to machine any job on any machine tool at any simple or compound angle, according to the manufacturer. Their new bulletin includes specific details

on construction and use of these vises and is available from the Universal Vise & Tool Co., Dept. F, Parma, Mich.

GROUP DRIVES—Complete information on their engineering and maintenance is included in Cling-Surface Co.'s new "Handbook on Modern Power Transmission for Industry." Main message of the book is the simplicity of converting from individual to group drives with the consequent reduction in equipment needed for effective operation. Requests should be addressed to Dept. H, 1048 Niagara St., Buffalo, N. Y.

200 TYPES OF CASTINGS—in both gray iron and Meehanite are included in the new 32-page booklet issued by Hamilton Foundry & Machine Co., Dept. J, 1551 Lincoln Ave., Hamilton, O. Both industrial and ornamental castings are included as well as considerable historical and technical information.

THE GUERIN PROCESS—of using Masonite Die Stock is described in a recent pamphlet issued by the Masonite Corp., Dept. TJ-4, 111 W. Washington St., Chicago, Ill. Masonite die stock is durable, despite the fact that it is approximately one-sixth the weight of steel for the same volume, and can be used economically for tooling small experimental runs or large production jobs. The catalog, entitled "Masonite Die Stock", is available upon request.

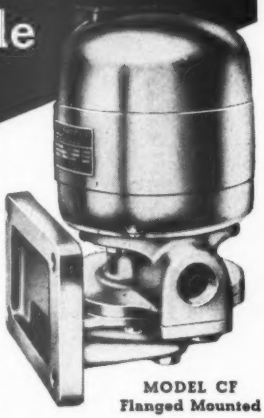
MALL PORTABLE MACHINES—for polishing, sanding, buffing, grinding, wire bushing, drilling, etc.—are described in Form 119-A of the Mall Tool Co., 7743 S. Chicago Ave., Chicago, Ill. Particularly emphasized are the Mall portable flexible shaft grinders. All machines are designed to deliver the maximum of power to the working tool with the minimum of weight in the operator's hands.

BORING AND TURNING MILL—The new King 62" heavy duty boring and turning mill is described in detail and illustrated from all angles in a folder issued by The King Machine Tool Co., Dept. J, Cincinnati, O. Complete construction and operating specifications are included.

OIL PURIFICATION—"The Installation and Operation of a Honan-Crane Oil Purifier" has just been published by The Honan-Crane Corp., 802 Wabash Ave., Lebanon, Ind. Included in the manual are such subjects as placing the purifier in operation, refilling instructions, factors affecting operation, when to change oils, etc.

SID TOOL CO. CATALOG—Such well known products as Super Standard Tools, Palmgren Angle Vises, Thompson Universal Milling Fixtures and the Koch Test Indicator are included in this 1943 catalog. Inquiries should be addressed to Sid Tool Co., Dept. H, Mulberry St., New York, N. Y.

GILBARCO
COOLANT PUMPS
dependable...
durable



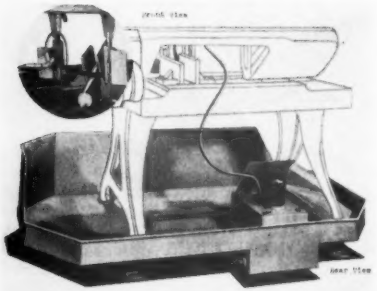
- One of a complete line of pumps for all machining operations.
- Built for twenty-four hours a day service.
- Instantaneous coolant delivery, self-priming, never becomes air-bound.
- Does not build up pressure at slow speeds.
- Positive mechanical seal, ball bearings throughout—unharmed by running dry.
- Built by one of the country's largest pump manufacturers.

Write or wire for literature, prices and deliveries.

MODEL CF
Flanged Mounted

GILBERT & BARKER MFG. CO.
WEST SPRINGFIELD, MASS.

New Coolant System for Horizontal Band Saws



GRAY-MILLS Model A-60 Coolant System for Horizontal Band Saws

A NEW coolant system developed by Gray-Mills Co. brings the advantage of using coolants in metal cutting operations to the horizontal type band saw with an estimated likely production increase of 150%.

The new system, designed to fit all types of horizontal band saws, is a result of careful laboratory tests by Gray-Mills which demonstrated that coolants, properly applied, allowed saw speeds to be increased, with smoother cuts and reduced blade wear.

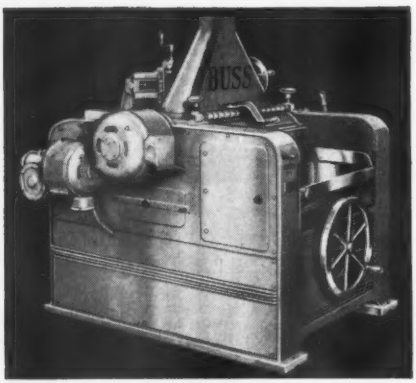
In this coolant system, a Gray-Mills pump of ample capacity is mounted in a coolant return pan, which in turn is attached below the saw to the legs. Being larger than the saw itself, the pan catches all fluid and returns it to the pump for recirculation. Anti-splash shield guards the pump and operator from oil.

The entire system is easily attached or removed; no drilling or alteration of the saw is necessary. Another unusual feature is found in the oil feed tube which is slotted to fit the saw blade, assuring a full distribution of oil over the blade.

A specially blended cutting oil for band saw applications has been developed by Gray-Mills to assure highest saw cutting effiency. Called "Flo-Bac" Saw-Kut No. 5, it has been added to the company's line of "Flo-Bac" Coolants.

For further information write to the Gray-Mills Co., Department H, 211 W. Ontario St., Chicago, Ill.

BUSS *Wood Surfacers*



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—plus faster change-over, greater convenience of operation and the assurance of years of perfect service. Write for Bulletins Type 4-L showing the many patented features which make this the finest of all surfacers for pattern and jig departments. Production Models to suit every circumstance. We specialize in surfacers.

BUSS MACHINE WORKS
214 EIGHTH ST. HOLLAND, MICH.

Modern Milling Fixture Design

(Continued from Page 84)

ing one connecting rod and one clamp in a single setting. A hole previously bored in the small end of the connecting rod registers the work when placed over a positive pin, and a semicircular clamp shown between the parting cuts, in the half-bore, holds the piece firmly when the nut in front of the clamp is tightened. The nut in front of the half-bore clamp must be tightened before the clamps over the work are tightened, as explained previously. A coolant is supplied through the two pipes shown in the picture. The parting faces are machined from the center line of the registered hole.

The finishing specifications are "fair" and the tolerance is plus or minus 0.005". Cutting speed 48'; feed two inches per minute; output 10 per hour.

Straddle Milling an Automobile Part

In Fig. 99 the picture of a piece to be straddle milled is seen laying on the fixture body. The work is of cast iron and its name is a reverse shifter bracket. This operation is an automotive job. No lubricants are used when milling cast iron parts.

The piece is located against the tool steel hardened face seen on the left front in the fixture. It is located against the plate over two pins which enter holes in the piece. The holes were previously drilled in a drill jig. This work has had a previous milling operation in which its two parallel sides were finished.

A clamp that holds the piece is operated at the right side of the fixture by tightening the screw-head, which is provided with four hand spokes. This screw has a convenient location, safely away from the cutters, and the spokes provide a handy and positive grip for the operator's hand. The cutters used are of the side milling type, each 6" in diameter and made of high speed steel. The oper-

(Continued on Page 184)

C-F POSITIONERS

. . . now faster, better welding

C-F POSITIONERS are enabling many manufacturers to make their products better and at lower costs by changing over to **WELDING.** Positioned welding speeds production, improves the quality of welds and reduces handling costs to an absolute minimum.

With a C-F POSITIONER all sides, top and bottom of a weldment can be welded "down hand" with a single set-up. Without the services of a crane or crane crew, the welder himself positions the weldment, rotates it (to 360°) or tilts it (to 135° beyond horizontal) with a push button control. Large variety of models and types in capacities from 1200 to 30,000 lbs. All adjustable for height and pedestal mounted to give maximum clearance.

Write for Bulletin WP 22.

CULLEN-FRIESTEDT CO.,
1316 S. KILBOURN AVE. CHICAGO, ILLINOIS

(Continued from Page 183)

ation consists of facing the round boss, seen in the angle of the piece, and the other end opposite to the boss. Cutting speed is 63 rpm, feed 7" per minute and the hourly output is 59 pieces.

This fixture is provided with a "feeler gage." The gage is the surface of the angle on the edge of the hardened plate that projects under the first cutter in the picture. The purpose of a feeler gage is to avoid spoiling about a dozen pieces of work when taking the first cuts after the initial setup. With this gage the correct position of the table, fixture and work, in relation to the cutters, can be readily determined so that the first piece will be milled right.

When the milling position is right the space between the front edge of the hardened face plate and the edges of the side cutter teeth is 0.125". The machine setter inserts a 0.125" thick feeler blade in the space between the gage and cutting teeth. If necessary, he moves the table to suit the feeler blade, until the horizontal location of the fixture and work are properly determined before any cuts are made. The table is then locked in its correct position and the job is ready to be run. In cases where depth cuts are also involved, there are two places to insert the feeler blade—one clearance space under the cutter and another at its side.

(Photos courtesy of The Cincinnati Milling Machine Co.)

Get Longer Life From Your

PERISHABLE TOOLS

HILCO UNIVERSAL TOOL and CUTTER-GRINDER

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New Dust Cutter

A SAFE, effective method to remove rust, shop dirt and stains from factory windows without using a costly and dangerous acid bath is announced by Berman Chemical Co. Saf-T-Klenz is not only excellent for windows, according to the manufacturer, but also speedily removes iron rust, lime deposits, soap oils, body grease and discolorations from shower room floors and walls, wash bowls, toilet bowls and fountains, it causes obnoxious odors to immediately vanish.

This cleaning material comes in convenient non-deteriorating dry powder form and is unconditionally guaranteed.

A free trial sample and more information will be sent upon request to Berman Chemical Co., 356 Tenth St., Toledo, O.

(Continued from Page 135)

as a carburized surface does not produce a soft skin on the 1.5% carbon — 12% chromium type of air hardening steel, carburizing atmospheres, such as produced by cracking liquid hydrocarbons or by packing in charcoal, can be used, provided a carburized surface is not objectionable to the application of the tool.

The hardening procedure used on the 1.5% carbon—12% chromium, high-carbon high-chromium air hardening steel is different in many respects from the 1% carbon—5% chromium—1% molybdenum air hardening type. It is very desirable on the 1.5% carbon—12% chromium steel to use a preheat at 1450-1500° F and allow the steel to soak at preheat temperature for at least one-half hour. A hardening temperature of 1850° F is the average temperature for hardening the steel.

Unlike the procedure used for hardening the 1% carbon—5% chromium—1% molybdenum type, the 1.5% carbon—12% chromium type should be soaked for a minimum of one-half hour, for sections over one inch, after the steel has reached the hardening temperature. Because of the higher alloy content in the high-carbon high-chromium type, the steel must be soaked longer to get the carbon into solution. Full hardness may be obtained without a long soak, but the steel will not have the maximum wear resistance, and therefore will not give the high production runs that this type of steel is capable of producing.

The same rules for quenching should be followed as were pointed out above for the 1% carbon—5% chromium—1% molybdenum type.

The tempering of the 1.5% carbon—12% chromium high-carbon high-chromium air hardening type for blanking or trimming punches and dies, gages, etc., requiring a hardness of Rockwell 61-62 "C" can be obtained at a temperature of 350-400° F, or from 950-1000° F.

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MANY TEDIOUS JOBS
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Duro Hand Grinders are powerful and durable. The G. E. Universal Motor develops 42 watts output running at 24,000 R.P.M. Kept cool in operation by propeller type fan. Spindle operates on sealed N. D. ball bearings which take up all radial and thrust load. Fitted with collet chuck up to ⅛" capacity. Streamlined to fit operator's hand. Ideal for tool post grinding.
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HAND
GRINDER
DURO FOR DURABILITY★
FOR DIE WORK
FOR TOOL POST GRINDING
FOR POLISHING
FOR ROUTING
FOR DRILLING
FOR

(Continued from Page 185)

This steel, unlike the 1% carbon—5% chromium—1% molybdenum type, possesses a secondary hardness range with the maximum hardness in the secondary range at 950° F when using a hardening temperature of 1850° F. If a hardening temperature of 1900° F is used, the maximum hardness will be found in the secondary range at 1000° F.

From a practical experience, blanking punches and dies seem to be tougher, and stand up better with the 950° F draw to obtain a 61-62 "C" than with a 350° F draw for the same hardness. If a hardness of 63 "C" is desired, then a draw of 300° F will have to be used, unless the steel is carburized. A minimum time of two hours at temperature should be used for small tools and a minimum time of 4 to 6 hours should be used for tools over one inch in section. Hardness values obtained at various draw temperatures are shown in the accompanying chart.

This material is taken from an article in "Heat Treating Hints", published by Lindberg Engineering Co.

War Production Rulings

New rulings of the War Production Board of importance to the tool and die industry have recently been made public. To provide a reasonable flexibility in the requirement that a certain percentage of all high speed steel orders be of molybdenum types, the War Production Board today amended Order M-21-h (tool steel).

The order had required that 75% of all high speed steel orders accepted in any calendar quarter be Class A (molybdenum type), and not more than 25% be Class B (tungsten type). Because literal compliance with this provision has been

found to be difficult, the amended M-21-h provides that orders and deliveries of high speed steel to any person in any calendar quarter which balance within five per cent by weight, or within 500 lbs. (whichever is smaller) of the required ratio is not a violation of the order.

In addition, those whose total receipts of high speed steel do not exceed 100 lbs. per calendar quarter are exempted from complying with the 75 to 25% ratio.

Another important order is the prohibition placed upon steel producers forbidding the shipping of normalized or heat treated carbon or alloy steels on any commercial warehouse order. However, if steel to fill such orders has already been normalized or heat treated, or is now in process of being, it may be shipped when and as completed, if the orders are otherwise validated in accordance with WPB regulations.

The order (Direction 5 under Controlled Materials Plan Regulation 1) does not apply to shipments to warehouse stocks earmarked for aircraft use or for direct shipment to a manufacturer of aircraft or aircraft parts.

The cause for the ruling was the fact that warehouses have placed orders for these particular types of steels to an extent which endangered deliveries for more important purposes.

Under Conservation Order M-302, as amended, the War Production Board drastically curtailed the amounts of osmium alloys that may be used in the manufacture of fountain pen points and long-life phonograph needles. It is the purpose of the order to conserve the entire supply of osmium for military purposes, with the exception of any existing stocks of certain special alloys that are unsuitable for military consumption.

Unlike the original order, which allowed unrestricted use of non-military

(Continued on Page 188)

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INDEXING AND HOLDING
FIXTURES!
The applications shown here are only two out of very many which make difficult jobs easy and turn out two parts where only one grew before . . . Zagar Fixtures simplify milling, drilling, tapping, slotting and grinding operations. One handle opens, closes, indexes. Simple in design, rugged, quick, easy to use. Two sizes, 1" and 2", in both types. . . . Before you buy or build a special fixture for that next job, investigate Zagars.
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2" Zagar Index Fixture with master collet and pads, milling wrench squares with all-standard equipment.
CONTINUOUS PRODUCTION. Two 2" Zagar Holding Fixtures permit one part to be loaded while another is cut.
COLLETS
In stock — Zagar No. 2 and No. 6 Collets, similar to W. & S. No. 2 and No. 6 Collets.
ZAGAR TOOL, INC.
23880 Lakeland Blvd. Cleveland, Ohio

(Continued from Page 187)

types of osmium alloys produced prior to issuance of the order, the amended regulation will compel a 50% reduction in consumption for non-military purposes.

The General Preference Order E-5-a issued by WPB controls the distribution of new gages and precision measuring hand tools. The term takes in micrometers, verniers, calipers, rules and similar precision tools used in production, whether sold to the manufacturer or the individual employee. The term also includes gage blocks, external and internal thread gages, round internal and external gages and other like measuring devices.

Sales by producers or distributors of new gages or precision measuring hand tools are restricted to (1) approved users, (2) other distributors, and (3) approved employees. Each of these terms is clearly defined in the order and essential points to observe before such a tool can be bought or sold are included.

In the past few weeks, several large war industries have announced significant changes in their executive personnel.

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WALTHAM GAUGE COMPANY

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Important Industrial Appointments

The Jessop Steel Co., Washington, Pa., has just appointed Robert K. Kulp director of research. Mr. Kulp is a member of the American Society for Metals and the American Foundrymen's Association.

New director of Industrial Marketing and Research for The Dumore Co. of Racine, Wis., is James Tate, former vice-president and general sales manager of the Delta Manufacturing Co. Mr. Tate will be responsible for planning Dumore's marketing and manufacturing program in the post-war era.

Helge G. Hoglund, sales manager of the Machine Tool Division of Van Norman

Machine Tool Co. for the past ten years, has been promoted to vice-president of the company. Mr. Hoglund will continue to be in charge of sales of the Machine Tool Division. In addition, he will have complete control of sales of the new Electronics Division which is manufacturing induction heating equipment.

Appointment is announced by the Allen Manufacturing Co., Hartford, Conn., of Ellsworth Brash, III, as district representative for Pennsylvania and New York State, except greater New York City and Long Island. The latter areas will continue to be served by Allen representative Willis D. Horner.

At the age of 71, A. L. Patrick, president of The Cleveland Automatic Machine Co. for the past decade, has retired from that office. Mr. Patrick's resignation was followed by the election of Col. James Hammond, formerly Chairman of the Board, as president and treasurer, and Mr. Patrick as Chairman of the Board. G. V. Patrick, vice-president, became executive vice-president.

Otto W. Winter has resigned as vice-president of Republic Drill & Tool Co., Chicago, to become president of Sav-Way Industries of Detroit. Mr. Winter is immediate past president of the American Society of Tool Engineers and is national chairman of the society's committee on Education and Emergency Training. He is also a member of American Society of Mechanical Engineers, American Society for Metals, American Society of Welding Engineers, Society of American Military Engineers.

Another new appointment just announced by Sav-Way is that of Ted Nagle as sales promotion and advertising manager. Mr. Nagle was with General Motors and Bendix Aviation Corp., and before that was president of his own company, Ted Nagle Equipment Corp., manufacturers of automotive equipment and electric chassis dynamometers.

(Continued on Page 190)

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EXTRA SPEED

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1/6 H.P.
35,000 R.P.M.
Weighs only
35 oz.

Operates at high speeds never equalled by any other electric hand tool. Weighs only 35 ounces yet develops 1/6 H.P. under full load. ● Higher speed means faster, better work; also cool working surfaces saving wear on wheels and cutters by as much as 50%. Cuts non-ferrous metals up to 350 Brinell hardness without heat.

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New COOLFLEX flexible shaft attachment extends full power and speed of the PRECISE 35 to the small, cool-running handpiece. Only PRECISE 35 offers this advanced feature.

PRECISE PRODUCTS CORPORATION
719 Racine St. ◆ Racine, Wisconsin

THE PRECISE 35

INDUSTRIAL DIGEST

(Continued from Page 189)

New Die Producing Process

A method for large-scale manufacture of "template dies" for the aircraft and similar industries has been developed by the newly organized Algoma Products Co. of Detroit, according to L. Hoster, general manager.

In discussing the new dies, Mr. Hoster said, "While the principle itself of making dies from templates of parts is not new, we believe we have developed a process of producing such dies which will result in far lower costs and quicker production than has heretofore been possible. It was our idea, in starting on this development, to provide facilities to produce blanking and piercing dies on a real 'production' basis.

"In view of the fact that it is necessary for the aircraft industry to continuously modify designs of aircraft as battle experience is gained, it has become particularly vital that such changes shall be effected in the minimum of time. In the past, it has taken entirely too long to prepare die designs and produce the new designs required before a change can be put into effect. We hope with Algoma template dies and the production process we have evolved to do in a few hours what normally requires weeks, even months.

"The new dies eliminate entirely the necessity for separate die design and do not require highly specialized production equipment. Moreover, the process has been laid out in such a manner that we do not require a large number of die makers. Much of the production can be handled by mechanics with only normal skill in the operation of specific types of conventional machine tools."

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are the profitable answer to many small riveting operations where rivet heads must be uniform in size and tightness.

Radial thrust bearing carries both the radial load and the riveting thrust load, a feature which greatly extends bearing life. Frames are sufficiently heavy to prevent machine spring.

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(Continued from Page 96)

and basic medicaments adequate for any ordinary emergency.

The ninth step is for the company to make a general announcement of its safety program to acquaint the workers with the fact that an organized effort is under way to prevent accidents which needs full employee co-operation to be effective. The announcement should stress the fact that the company is prepared to do everything within its power to make working conditions safe, and in return expects the worker to do everything within his power to further the program. Workers should also be encouraged from the start to make their personal contributions to safety.

The tenth step is to organize the educational program. Management as well as the foremen and other employees must enter into this program. The safety director must see to it that the manager gets periodic reports on meetings and concrete progress as the program develops acceptance and strength. Safety committees should be formed, with responsibilities in the matter of safety education.

The size of the company and the nature of its business are usually the determining factors in setting up the overall plant safety committee. A typical committee consists of the plant manager, superintendent, plant engineer, master mechanic, safety director, purchasing agent, employment manager, company physician, one or more foremen, and one or more workers. This executive committee can be supplemented by shop committees in even closer touch with the workers.

Regular courses of instruction for foremen under the leadership of the safety director, to be followed in due time by a regular regime of instruction by the foremen themselves given to the men, are basic in the education program.

The eleventh and last step is to consider methods for improving machinery, equipment and processes so as to eliminate hazard as nearly as possible and to increase production efficiency.

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Engines lathes can be used for finishing operations on small parts—for less output and at more expense. "Keep 'em turning". . but on machining operations.
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Metallizing Is Saving War Materials

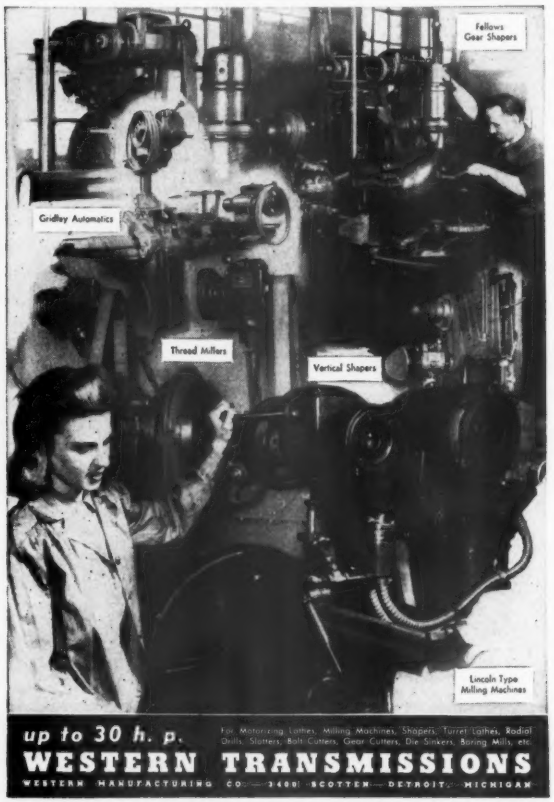
(Continued from Page 82)

loys will require the same tool settings or speeds to obtain uniform results. Some alloys will require different speeds and tool settings than others.

After the rough threading operation has been completed, it is important that the surface be protected against contamination. It is best, of course, to spray the rod as soon as the threading has been completed. If the part which has been prepared is to be left for any length of time, it should be wrapped with clean paper for protection. When the part is left exposed, atmospheric deposits are apt to cause trouble. This is particularly true on wet, humid days. On the other hand, when the humidity is low, as much as 24 hours may elapse without any danger of contamination occurring.

Sand-Blasting

In view of the fact that some alloy shafts are either case hardened, nitrided or so hard throughout that ordinary machine tools cannot be used to under-cut the worn area, sand-blasting must be employed as a means of preparing the metal. In this operation it is necessary to grind the worn metal away, mask the ends and sand-blast thoroughly. Whenever possible it is well to use a diamond point chisel to nick the area before sand-blasting.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In preparing used cast iron, bronzes or brass casting for metallizing these metals must be heated to the point to drive off any oil or grease that may have been absorbed. This heating should be done with care to avoid warping.

This same condition is likely to be found in previously welded shafts. Since the base metal rarely gets hotter than about 200° F, crankshafts, high speed shafts, and armatures, may be processed in this manner without any danger of warpage or distortion from heat.

Electric Bonding Method

The third and newest method of preparing surfaces for metallizing is the Electric

Bonding method. This process employs rods for bonding which may be obtained at any welding source. One, two or three foot lengths of metal wire in any of the following metals may be used to perfect the bond: Pure Nickel, rod or wire, Monel, or Nickel Alloy.

One equipment manufacturer has developed an Electric Bonder with which it is possible to exert localized control in operation of metal preparation. It is also possible to prepare other metals such as bronzes and brass and those metals that do not contain a high percentage of lead. Hard to get at places and parts which are apt to be damaged by sand-blasting can be prepared without any fear of injury. Thus the masking off of certain parts for protection — essential in the sand-blasting — is not required with this process.

The Electric Bonder makes it possible for the operator to get into small corners and into internal diameter easily. It is possible to bond a cylindrical surface with the Electric Bonder at approximately the same speed as rough threading.

This bonder has an air-cooled electrode holder (patented). Its construction is simple. It provides safety to the operator. The electrode itself is kept cool, permitting high speed bonding. It uses but one electrode and high speed efficiency in applying the bond is obtained without high peaks on the metal surface. It eliminates the possibility of excess carbon or dirt getting into the work which might have a tendency to give a false bond.

The air cooling system which is employed in this bonder eliminates the possibility of the work becoming overheated, pre-hardened or distorted. The air cooling also serves to accomplish other needs in the bonding operation. It keeps the work clean and free from excess carbon deposits; it blows the flash sparks away from the operator; it maintains the control of the temperature of the electrode wire; and probably most important of all, it controls the density of the deposit.

(Continued on Page 194)

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Heavily insulated with 8" hi-temperature, quality insulation. Pot size, 14" diameter, 20" deep. Location of burners, near top of combustion chamber, insures longer pot life. A vent damper regulates the flow of exhaust gases. Top of the ring, in 3 sections, prevents cracking or distortion. Use with a large blower for maximum performance.
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(Continued from Page 193)

At high pressure, that is 75 lbs. p.s.i., the very fine and very dense deposit is obtained. High pressures are used for certain emergency jobs—filling in cracks such as blocks and press fits, etc. By reducing the pressure to 30 lbs. p.s.i., the denser coarser bond is obtained. Naturally at slower speeds more air will be required for cooling. With the Electric Bonding machine the operator has a wide selection of deposit factors when lathe speeds, surface diameter, air variables and current selector combinations are used.

Spraying Technique

With the metallizing gun mounted in the lathe tool post, adjustments are made in the gas pressure of the gun and it is moved opposite one end of the prepared rod. The gun is lighted and pointed away from the work until complete atomization is attained. The shaft part to be sprayed should be sprayed from the center until the part is built up enough over-size to allow for finishing. When one spot is built up sufficiently the carriage is moved along enough to start a new one and continue in this manner until the shaft is built up for its entire length. Unless it has been necessary to under-cut the part very deeply it is best to build up with one complete pass of the gun.

If the finishing is done in the lathe, the work can be started as soon as the spraying is completed. By the time the rough threaded, sand-blasted or electric bonded surface has been completely metallized the part will be cold enough to finish to size. Where grinding facilities are available it is always best to grind the finish regardless of the type of steel used.

Rough threading, sand-blasting or electric bonding are the best means of preparing parts for metallizing. The use of knurling as a means of preparation is not recommended. A recent test made by a laboratory of an eastern corporation using metallizing equipment proves the superiority of the other methods rather conclusively. The photomicrograph shows two bonds —one made using the recommended method, the other by the knurling method using knurling tools. The dark areas show the non-bonding surfaces—very noticeable in the knurled surface—but in no way apparent with the surface prepared with metallizing equipment.

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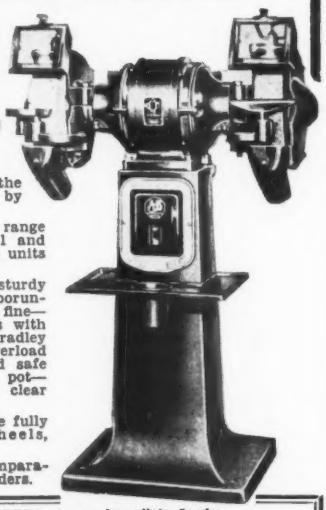

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Surfaces which have been sprayed by the metallizing process are very strong and durable. It is not necessary to apply a heavy coat of metal to them. It has been found that a thinner coat, being less rigid, is sufficiently strong to stretch the amount necessary for it to follow the base metal. While each metal has a different thickness limitation, generally the thinner coat is better than the heavier.

Spraying for Corrosion Prevention

Another important application of metallizing in maintenance is the protection of various metal surfaces from corrosion. Such surfaces are prepared for metallizing by sand-blasting, using steel shot in the blasting operation. However, in warm coastal areas it is impractical to use steel shot because the salt air causes it to rust. This rust is transferred to the surface to be sprayed and it will be impossible to get a good bond for spraying. Therefore, in areas where steel shot can't be used, flint grit is recommended. This should be very sharp since it is not only necessary to clean the surface thoroughly but to produce a keyed surface for the tiny metal particles to cling to.

In spraying flat surfaces, the thickness of the applied metal is definitely limited. Too heavy an application is not recommended since if too much metal is deposited its strength becomes such that the mechanical bond is sheared when the base metal expands or contracts.

Steel Cartridge Cases

(Continued from Page 90)

A standard forging grease or graphite paste is used to lubricate the dies and there is no trouble with sticking of the formed piece because a stripper on the punch removes the part on the upstroke of the punch.

In the early stages of the work only one hot cupping operation was used, but it was later determined that better results could be obtained if a second hot operation was carried out after the piece had cooled somewhat. See Fig. 4. The second hot press is the same as the first, except for slightly altered tooling ex-

(Continued on Page 197)

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(Continued from Page 195)

tending the draw two inches further, or to about six inches.

After the original set-up was worked out, an extra operation was added to control the wall thickness. The cup is cold sized in a press, drawing it out only slightly. This is done after the hot redrawn cup has cooled in air.

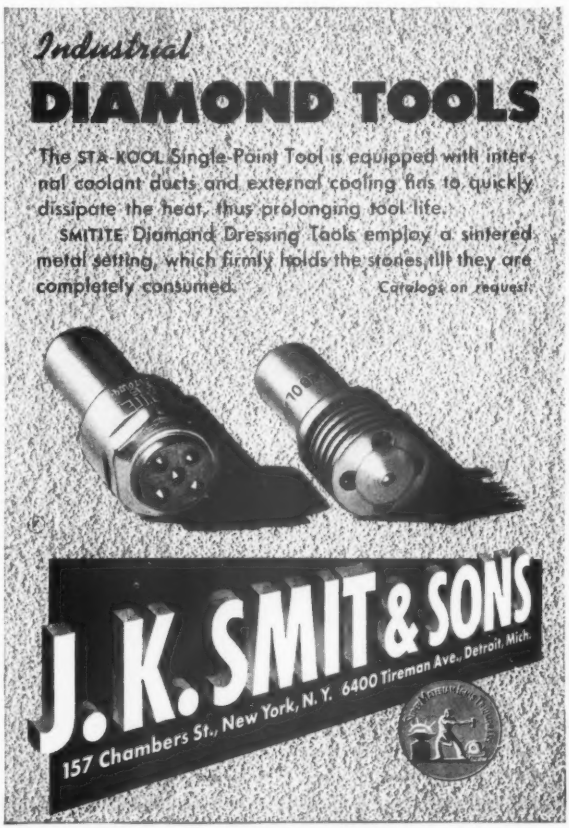
After annealing, followed by acid pickling and washing to remove scale, the head of the cup is coined in a crank press. This operation sizes it accurately as well as giving this portion of the case some extra cold work, because in the subsequent cold drawing operations the head does not receive as much work as the walls. Bonderite treatments serve both to clean the surface of the case thoroughly and to etch it slightly so that minute pockets will retain drawing compound in the cold operations. See Fig. 5. Further, the thin surface layer of zinc phosphate deposited in this chemical treatment acts as a lubricant during cold drawing.

Hydrogen embrittlement resulting from the acid pickling and bonderite operations tends to cause breakage during cold drawing. This trouble is eliminated by annealing which drives off absorbed hydrogen.

Perhaps the most interesting step in the entire operation is the series of four cold drawing operations, all carried out on a single 750-ton Clearing double acting press. See Fig. 6. The four punch and die stations are placed to form the four corners of a rectangle well within the normal platen area, and are so arranged as to carry approximately an equal load, of somewhere near 150 tons per station. The depth of draw varies slightly over the four dies, being controlled by the length of the punch. The cartridge case progresses from the left hand die to the right hand die on one side of the press and is then handed through the die opening and placed on the die directly across from the second station, finally moving to the right hand die on that side. Four operators handle the press, one at each die. Each punch has an integral mechanical stripper which removes the part after drawing.

On this press, the six-inch cup is drawn to 15 inches and to the approximate form of the finished case, a total

(Continued on Page 199)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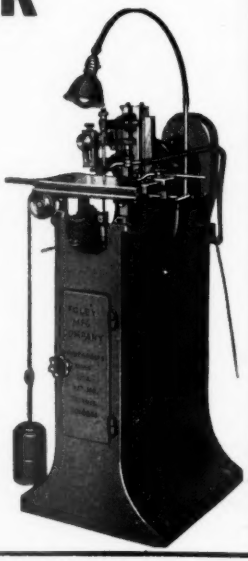
The STA-KOOL Single-Point Tool is equipped with internal coolant ducts and external cooling fins to quickly dissipate the heat, thus prolonging tool life.
SMITITE Diamond Dressing Tools employ a sintered metal setting, which firmly holds the stones till they are completely consumed.
Catalogs on request
J. K. SMIT & SONS
157 Chambers St., New York, N. Y. 6400 Tireman Ave., Detroit, Mich.

FOLEY DIE MAKER

Completely finish files all Through Type Dies



Handles most intricate dies with small holes and sharp corners, as only smallest lead hole through which saw or file can pass is necessary. Compound angle filing is fast, accurate and easy with the **Foley Die-Making Machine.** Adjustable table tilts 20° front, 10° back. Ram tilts 20° right or left. Has 6⅜" throat—saws to center of 12¾" piece.

USES ANY STANDARD OR SPECIAL FILES—From the smallest needle file to the coarsest bastard file can be used in this machine without any special holding fixtures.

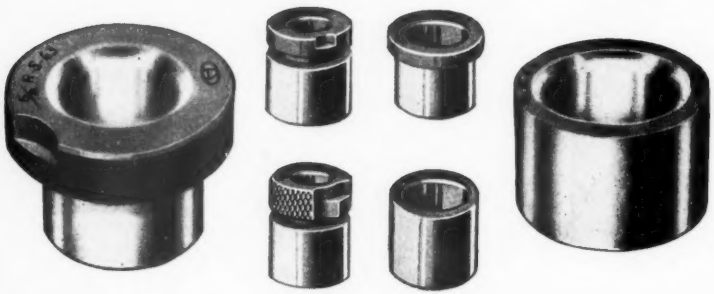
TAKES ANY SAW—Any type of saw from the finest saw to the high power high speed saw can be used without delay of changing holding fixtures. No holes in blade necessary.

PAYS FOR ITSELF—The **Foley Die-Making Machine** usually pays for itself in 400 working hours. Write today for literature and full details.

FOLEY MFG. CO. 4 Second Street N. E., Minneapolis, Minn.

Manufacturers of FOLEY Automatic Saw Filers, Grinders, etc.

DRILL JIG BUSHINGS



Get details on Acme Optical Flats and Monochromatic Lamp.

ACME INDUSTRIAL COMPANY

Makers of Hardened and Ground Precision Parts

206 N. Laflin St. **Chicago, Ill.** **MONroe 4122**

(Continued from Page 197)

draw of nine inches with no substantial change in diameter. This is a real test of the drawing qualities of the steel, and it is noteworthy that few pieces are torn or split in these severe operations. A special drawing compound was developed, the base material of which is machine oil.

The case is cold headed in a press equipped with a two-stage indexing die, the lower die being built so that after the first stroke it can be moved across the press, bringing the second die impression under the punch carrying the case. See Fig. 7. In these operations the steel in the base is flared out so that the flange can be machined, the steel to fill this expanded rim being furnished by the extra thickness formed around the outer edge in the original hot cup.

Annealing before tapering is quite critical. See Fig. 8. It is limited at the mouth end to a depth of about two inches to prevent splits during tapering. The temperature is closely controlled. In this operation, the cases are mounted on a conveyer and moved between two rows of 2½-inch radiant gas burners.

These are mounted in a furnace horizontally at the proper height to concentrate the heat on the mouths of the cases as they travel through the furnace. The cases are rotated slowly as they move past the burners.

Tapering operations are perhaps the most critical of all steps since, in these two press operations, the cold steel must be made to flow into the desired taper without wrinkling or distortion and without the support of a punch on the inside. The case is simply forced up into a tapered die cavity in two stages both on the same press. The second stage does have a punch which extends about three and one-half inches into the case. This is required not for the overall taper but to support the metal in forming the reduced section at the mouth.

Punches used on all the cold drawing and tapering operations are made of

(Continued on Page 201)

Filing for Victory

with

OLIVER DIE MAKING MACHINES

Oliver Die Making Machines are fast and efficient on all sawing and filing operations. They save 50% to 60% of the labor over hand methods in the cost of making precision Dies, Gages, Cams, Templates and similar products requiring rapid and accurate sawing, filing and lapping operations.

It will pay you to investigate the line of Oliver Die Making Machines!

SEND FOR LITERATURE

OLIVER INSTRUMENT CO.

1436 Maumee St., E. Adrian, Mich.

MAJESTIC INTERNAL GRINDING MACHINE

The Majestic Internal Grinder meets the exacting requirements for internal grinding operations in the tool room and die shop. It offers reliable, balanced operation, maximum output and valuable help for all-out production.

Sturdy and durable, the Majestic Internal Grinder is equipped with Parker spindle and motor. Parker ball bearings and standard rotor and stator assure perfect balance for smooth spindle movement.

An adjustable work head has a graduated base which swivels 90 degrees on each side of the center for taper grinding.

Send for valuable circular.

MAJESTIC TOOL AND MANUFACTURING CO.

2946 Woodbridge Street, East :-: :-: Detroit, Michigan

(Continued from Page 199)

hardened high speed steel chromium plated. The plating improves the wearing qualities and provides better antifrictional properties. Lower dies in the cold operations are generally steel rings with Tungsten carbide inserts on the working surfaces.

After the tapering operations the mouth end becomes appreciably harder because of the cold working, so it is annealed once more, this time to a depth of about three and one-half inches from the open end. This softens up the mouth and assures complete obturation in firing, that is, a tight seal in the gun barrel to prevent the explosion from blowing back into the breech.

The cases are inspected and transferred to automatic lathes which face the head, rough form the flange, finish form the flange and drill the primer hole. These lathes have five stations, four for the machining operations and one for loading and unloading. Reaming and counterboring the primer hole are performed on vertical machines and great care must be exercised in these operations since specified tolerances are unusually close.

Final stress relieving is performed in a batch type electric furnace accommodating 316 cases. This heat treatment adds roughly 10,000 p.s.i. to the yield and ultimate strength of the case.

The coating specified to provide protection against corrosion and sparking is an unpigmented baked phenolic varnish. Before painting, the cases are given a phosphoric acid pickle which provides a bond for the paint and also some additional protection against corrosion.

The painting and baking operations are fully automatic, the cases being mounted vertically on a conveyor with the open end up. They rest on fixtures attached to the conveyor chain so that as they pass the spray nozzles they can be spun by a motor-driven rubber belt. One spray nozzle is mounted on a traveling arm which descends into the case and lifts out at a uniform speed while the nozzle directs a spray of varnish over the rotating surface. At the same time, outside nozzles are positioned to coat the base and wall thoroughly and uniformly.

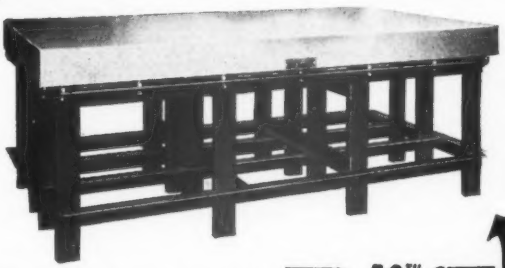
Once coated, the cases are carried

(Continued on Page 203)

BUILT FOR THE JOB

that's **CHALLENGE** *Semi-Steel*
LAYOUT SURFACE PLATES

When you require a smooth, true, rigid surface for layout, inspection or assembly work **Challenge Layout Surface Plates** will do the job . . . . and do it well!

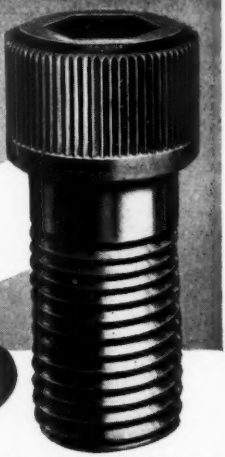


1893 50TH ANNIVERSARY 1943

● **Made in eight standard sizes up to 54x144 inches . . . all 6 inches thick. Special and larger sizes to order. Available with or without the sturdy, arc-welded all steel stand (shown above). Stand provided with lock leveling screws. Write for detailed information.** 484

THE CHALLENGE MACHINERY CO.
GRAND HAVEN, MICHIGAN, U.S.A.

BETTER FINGERS INSTEAD OF BUTTER FINGERS



With *KNURLED* SOCKET HEAD CAP SCREWS

UNBRAKO

Reg. U. S. Pat. Off.

The *knurling* of "UNBRAKO" Socket Head Cap Screws saves precious time—gears right to the fingers and prevents slip, lost time and motion. "UNBRAKO" Screws are precision made—have unbelievable strength—and are made in sizes #4 to 1½" dia.

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The KNURLING of Socket Screws originated with "Unbrako" years ago.

Speed - Smoothness - Accuracy
WITH THE
LEACH EXTERNAL GRINDER

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On small parts up to 7" in diameter, 11" in length.
Massive base and pedestal. Extra bearing area, 452 square inches of hand scraped bearing surfaces. Power feed—six table speeds—micrometer adjusted tail stock with spring action. Work spindle mounted on two precision roller bearings. Wheel head spindle mounted on three precision ball bearings. Hardened and ground tail stock and dead center spindles.

SPECIFICATIONS

Table Feeds—3/8", 1 1/16", 1 1/8", 1 1/2", 2 1/2", 3 3/8" per minute.
Work Spindle Speeds—73-104-144-213-294 revolutions per minute.
Wheel Spindle Speed—2750 rpm. Spring Action Tail Stock.
Capacity 1/8" to 7" diameter, 3/4" to 11" length.
Wheel—10" x 3/4" x 2". Tank Capacity—3 1/2 gallons.
Spindle Motor—1/3 hp, AC, 60 Cycle, 110/220 Volt. Wheel Head Motor—1 hp, AC, 60 Cycle, 110/220 Volt. Regular equipment includes emery wheel, diamond wheel dresser, belts and wrenches.

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A LEACH DISTRIBUTOR IN ALL PRINCIPAL CITIES

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PRICE
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Excellent Deliveries

H. LEACH MACHINERY CO.
385 Charles St., Providence, R. I.

(Continued from Page 201)

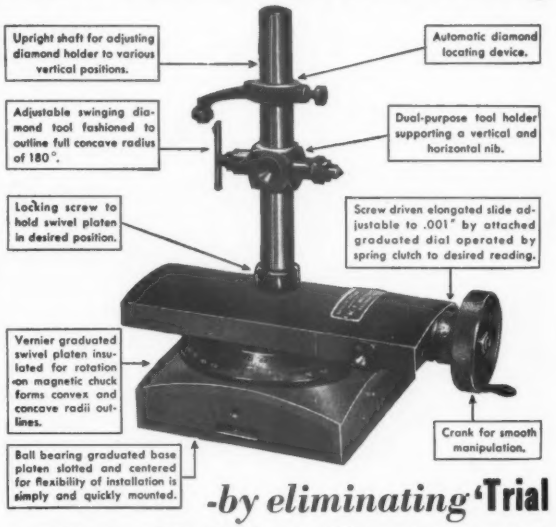
slowly between two banks of infra-red lamps, 64 on each side. The conveyor loops twice at the end of the lamp bank so that the cases travel three times through the baking zone, requiring 48 minutes in a temperature approximating 360° F. When they emerge at the opposite end from the painting station they pass through an exhaust cooling hood and out to an unloading station where they are thoroughly dry and cool enough to handle.

Inspection

The inspection of the 75 millimeter steel cartridge case starts with receipt of the raw material and ends with the final acceptance tests required by Ordnance. This inspection can be divided into three classifications, namely: raw material inspection, process inspection and final inspection for acceptance. Raw material inspection includes determination of chemical composition, grain size, inclusion rating, macrostructure and physical condition of the bar stock with respect to mechanical defects. Process inspection includes numerous dimensional checks, hardness tests and visual examination for physical defects which may occur in processing. Inspection for final acceptance by Ordnance covers hardness, micro and macro examination, ductility, corrosion and abrasion resistance and ballistic properties.

One unusual type of inspection tool has been developed to permit close observation of the interior wall of the case. A cone-shaped piece of steel slightly smaller in diameter than the case is chromium plated to a mirror finish on the outer surface of the cone. A wire is attached to the apex of the cone and a small light arranged to illuminate the interior of the case and the bright surface of the cone. The unit is lowered to the base of a case and drawn slowly upward while the inspector watches the mirror surface. The inner surface of the case is reflected in magnified form so that any surface defects are readily observed.

Short Cuts To Wheel Forming


Upright shaft for adjusting diamond holder to various vertical positions.
Automatic diamond locating device.
Adjustable swinging diamond tool fashioned to outline full concave radius of 180°.
Dual-purpose tool holder supporting a vertical and horizontal nib.
Locking screw to hold swivel platen in desired position.
Screw driven elongated slide adjustable to .001" by attached graduated dial operated by spring clutch to desired reading.
Vernier graduated swivel platen insulated for rotation on magnetic chuck forms convex and concave radii outlines.
Crank for smooth manipulation.
Ball bearing graduated base platen slotted and centered for flexibility of installation is simply and quickly mounted.

-by eliminating **'Trial and Error' Methods in Wheel Dressing**

The MEYERS' DIA-BRASIVE RADIUS-ANGLE FORMER is designed for simple and speedy installation on various machines, and engineered to perform with absolute precision in shaping and dressing grinding wheels. This is accomplished by eliminating the lost motion imposed by the "trial and error" method in forming difficult radial and angular outlines. Vertical and straight diamond dresser nibs are furnished as standard equipment. Write for literature and prices.

Aggressive manufacturers' representatives wanted in South, East and West.

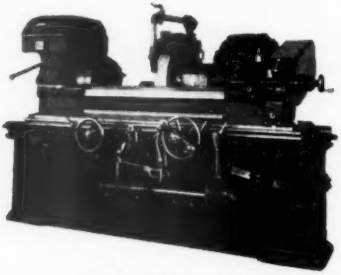
W. F. Meyers Co., Inc., Dept. T, Bedford, Ind.

HILL-CLARKE

Modernized

CYLINDRICAL GRINDERS

for **SUPER-GRINDING**
and **MICRO-FINISH**

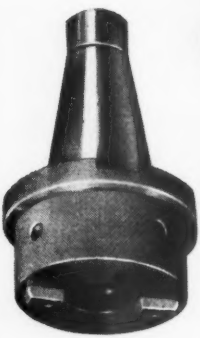


Hill-Clarke Modernized and Motorized Cylindrical Grinders offer refinements in design which minimize vibration and assure extreme accuracy on all grinding operations. One of these refinements, the Hill-Clarke Patented Multiple V-Belt Drive to work spindle, contributes to the smoothness in operation which makes possible a finish within a few micro-inches even when using standard grain free-cutting wheels. Investigate today by sending for a copy of the Hill-Clarke catalog "Super Grinding."

SIZES AVAILABLE

10x36	10x72	14x72	16x72
10x50	14x50	14x96	18x96

HILL-CLARKE MACHINERY CO.
646 WASHINGTON BOULEVARD CHICAGO, ILL.



Master Unit
Fits in
Machine Spindle

Reduce Tool-Changing Time to 5 Seconds IN MILLING AND BORING . . !

With the Quick-Change Holder and interchangeable adaptors, tools in milling and boring operations can be changed in almost the twinkling of an eye. This is because, with the master unit installed in a machine spindle, any adaptor and tool assembly can be quickly attached, being locked in position by keys which are set or retracted by simply turning a collar on the master unit.

Once the tools for any particular job are fitted with adaptors, they can be interchanged in 5 seconds. On machines where frequent changing is necessary, the saving in time and labor will pay for the holder and adaptors in a few weeks' time. The adaptors are designed to take cutter arbors, end mills, face mills, side mills, boring cutters, drills, eccentric chucks, and other standard tools.

MILLING MACHINE ADAPTOR CORPORATION
1402 W. Fort St. Detroit, Mich.

Write for LITERATURE

Quick-Change **HOLDERS** AND ADAPTORS!

Infra-Red In Industry

(Continued from Page 94)

the male part by temperature reduction to a point where the shrinkage is great enough to permit the part to be dropped or pushed into place with light pressure.

Shrink fits require the heating of the female part by temperature increment to a point where the expansion is great enough to permit the male part to be dropped or pushed into place with light pressure.

Compound fits require the cooling of the male part and the heating of the female part; the assembly being made by dropping or pushing the cool male part into the warm female part.

The force, or press fit, has many proponents among production executives, because existing equipment available for heating produces dirty, or oily parts; and because cooling equipment with sufficient capacity to handle production is costly and far from free from operational and maintenance difficulties.

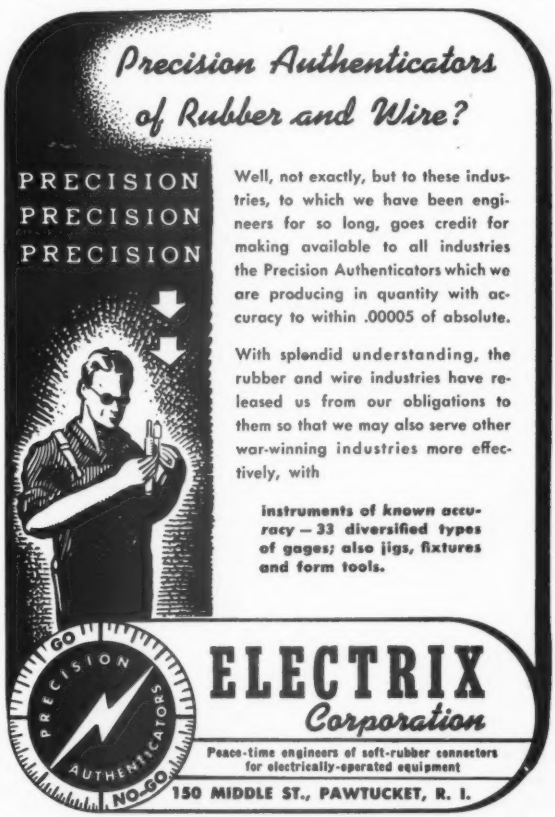
However, within the last eight months, many infra-red heater installations have been made for the purpose of heating parts for shrink fits. The advantages accruing from such equipment are numerous. In the first place, it heats quickly and the heated parts are free from dirt or oil. Moreover, the equipment is generally small and portable, and can be moved from one point to another in the production line, without displacing other equipment. Of prime importance is the fact that results can be accurately controlled on the job. The initial cost of such equipment is low and operating expense is negligible.

One large manufacturer of roller bearings definitely recommends the use of infra-red heating equipment for assembly of his bearings.

He recommends that the cone be a tight fit on a rotating shaft and the cup be a tight fit on a rotating housing. This will keep the cones from rotating on the shaft or the cups in the housing. If either does rotate, wear will occur between the races and the adjusting member with resultant bearing failures.

Sometimes, when they are pressed on, the shaft or housing might be gouged,

(Continued on Page 207)


Precision Authenticators of Rubber and Wire?
PRECISION
PRECISION
PRECISION
Well, not exactly, but to these industries, to which we have been engineers for so long, goes credit for making available to all industries the Precision Authenticators which we are producing in quantity with accuracy to within .00005 of absolute.
With splendid understanding, the rubber and wire industries have released us from our obligations to them so that we may also serve other war-winning industries more effectively, with
instruments of known accuracy — 33 diversified types of gages; also jigs, fixtures and form tools.
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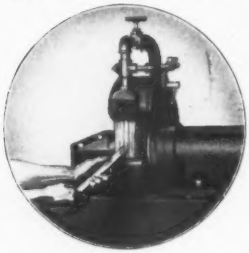
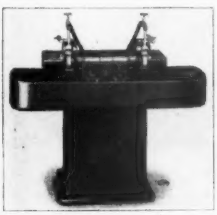
Peace-time engineers of soft-rubber connectors for electrically-operated equipment
150 MIDDLE ST., PAWTUCKET, R. I.

THERE'S NO DUST HERE



Grinding dust and grit ruins lungs and machinery. Hisey Wet Grinders keep it from getting there. And you don't need a big clumsy exhauster and air filter.

The steady adjustable flow of water carries with it all dust and grit generated by grinding and prevents burning the tool. The large pan and specially designed tool rests eliminate splash.



Made in sizes with 10 to 30" diameter wheels. Also made for drill grinding, single wheel types, and combination wet and dry with one wheel for snagging grinding. V-Belt drive assures correct speed for any size wheel.

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Scientifically selected and designed to conserve critical alloys and meet the carburizing or heat treating requirements of the Machine Tool and Aircraft industries. Call our nearest office and warehouse for up-to-the-minute information.

WHEELOCK, LOVEJOY & CO., INC.

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CHICAGO • NEWARK
DETROIT • BUFFALO
CINCINNATI

(Continued from Page 205)

and the particles of metal resulting would thus be free to circulate in the oil and cause damage, not only to bearings, but also to gears and seals.

Bearings should not be heated to expand for shrink fits above the temperature recommended by the bearing manufacturer. In no case should they be heated closer than 50° F to the "critical" of the metal from which they are formed.

Heating of bearings by means of the infra-red ray process assures their assembly free from dust, grit, dirt and metal particles that might later interfere with efficient operation.

Other applications for infra-red heating equipment in industry include tempering carburized and hardened steels for maximum hardness; stress relieving deoxidized wrought copper and high brass; heating steel springs for stress relieving and for prevention of hydrogen embrittlement after cold working and electroplating; drying of parts after washing; the drying of sand cores or molds used in foundries; material testing; product testing; plastic powder and pre-form preheating; chemical processing; textile processes; synthetic rubber processing; bonding material on glass; paint, lacquer and enamel drying; blueprint drying, and many others.

Infra-Red Heating Equipment Design

Early infra-red installations were very crudely put together, being mostly an assembly of lamps and reflectors, with no reckoning of the many factors inherent in the application.

Today's infra-red ovens are well engineered to the application and the results obtained are amazingly improved.

Penetration is the important factor in infra-red heating. The rays produce a penetrating heat which is different from the heat effect of other heat methods. It is this penetrating power which provides the amazingly efficient heating results. The rays penetrate into the material to be heated, and heating immediately proceeds throughout.

The temperature attained by the work is the factor that determines the result. Temperature attained in a radiant oven is a function of:

(Continued on Page 209)

TWO MACHINES IN ONE!

For Die-Filing Use Top Table in Position Shown.

For Punch or Blind-Hole Filing Tilt Top Table Back, Use Lower Table.

DIE TABLE Filing From Below

PUNCH TABLE Filing From Above

No more hand filing of intricate jobs or inaccessible parts! With this Duplex Die and Punch Filing machine you can take care of all filing and lapping jobs as they come along. Stroke fully adjustable from 0 to 1½". Two Speeds. Fully enclosed motor. Ball Bearings throughout. No dripping of oil. No waste of unused file sections.

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Let us solve your
GRINDING
PROBLEMS

ACCURACY GUARANTEED

- End Mills
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Corporation
2329 Nelson St. Chicago, Ill.

New Socket Wrench

After a year of testing and refinement, the F & H Manufacturing Co. is offering for sale a new type of socket wrench, called the Wedge-Lock. This new wrench has no ratchet to limit movement, wear or break.

Two hardened steel free-moving shoes serve as an instantaneous acting clutch. As the point of the handle comes to a stop on the back swing, the wrench is immovably locked for the tightening pull.

This Wedge-Lock Reversible Clutch Type Wrench is available in four sizes: ¼", ⅜", ½" and ¾".

For further information write F & H Manufacturing Co., 2209 West Jefferson St., Los Angeles, Calif.

SAFETY STEEL TAMPS

Will Not Spall!
Will Not Mushroom!

Heavy Bevel LETTERS & FIGURES

These stamps will give an outstanding performance on any type of stamping job. Recommended for stamping armor plate, airplane parts, guns, tank parts and any other steel ordnance product. Will give at least 50% to 100% more service than ordinary stamps because of special alloy steel used. Heads of stamps do not have to be redressed. Available in all sizes $\frac{1}{32}$" to 1".

Write for prices and literature.

M. E. CUNNINGHAM CO.
MARKING DEVICES
104 E. Carson St. Pittsburgh, Pa.

(Continued from Page 207)

(1) B. T. U. per square inch available at the surface of the work.
(2) Percent of this energy absorbed by the work.
(3) Mass, specific heat and other characteristics of the work.
(4) Heat losses from the work by conduction, convection and low temperature radiation.

The rate of temperature rise of the work in an infra-red oven is dependent on the ability of the surface to absorb the radiant energy and on the concentration of the energy received. The final or equilibrium temperature is reached when the rate of heat loss to the surrounding atmosphere is equal to the rate of energy input.

Heat losses to the air depend on the difference between the temperature of the air and of the heated surface. Elevated air temperatures in radiant ovens reduce such losses and make possible the maintenance of the required work temperature with minimum energy input.

In radiant ovens of recent design the elevated air temperature is obtained as a by-product simply by providing insulation behind the reflectors and enclosing the side walls and top of the entire system. Such a system is called a radiant convection system.

A typical oven of this type for raising the temperature of various materials would have but one zone—a zone of high energy concentration in which the work is heated rapidly to the desired temperature.

The infra-red lamps in this oven are usually of the self-reflecting, parabolic type, placed in groups in elliptical, insulated reflectors. The lamps are arranged in the reflector in such a manner that the heat rays strike the work at many different angles—on the sides as well as the tops and bottoms.

A typical radiant-convection system for baking a normal synthetic enamel, and other drying applications, would

(Continued on Page 211)

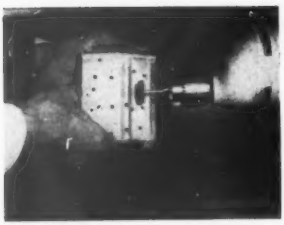
ALL-STAR PERFORMER

in

★ ★

FASTER, EASIER
DE-BURRING
CLEANING
FINISHING
POLISHING

★ ★



De-burring—finishing holes and edges in Alclad part.

The *Soft Rubber* Binder *Cushions* the Abrasive

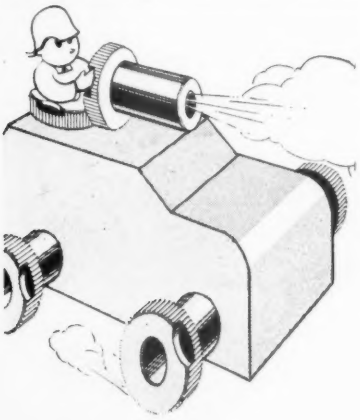
Resilient, "live" rubber binds and "cushions" Brightboy's abrasive all the way through!

The dimensional loss on the material worked is reduced to a minimum. Brightboy's close-tolerance, precision finish frequently serves as the final polish. Brightboy bridges the gap and saves work operations between a grind and a buff.

Easy-to-use Brightboy is made in wheels, blocks, sticks, rods and special shapes for manual and machine operations. No special setups required. Write us if your dealer cannot supply you with our catalogs and prices.

BRIGHTBOY INDUSTRIAL DIVISION
Weldon Roberts Rubber Co. Newark, N. J., U.S.A.

Industrial Abrasives, Inc., 3724 West 38th St., Chicago, Ill., announces the appointment of W. B. Muse as sales manager. According to L. H. Metzger, company president, the appointment of Mr. Muse heralds the introduction of several new items and the opening of a national program of new sales activities.



BIG GUNS FOR DRILLING HOLES

They're mighty small compared to a gun or a General Grant, but in building jigs for the manufacture of gun and tank parts or any other precision metal part it pays to use Universal Drill Bushings. Because of their straight and round superfinished bores, Universal Bushings save tools, wear longer and assure accuracy. Write for complete facts.

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We were the Originators of HIGH CARBON-HIGH CHROME Steels with NON-DEFORMING Qualities, opening the way to

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for all kinds of Dies and Press Tools with High Carbon-High Chrome Steel

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and

FORGINGS

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(Continued from Page 209)

have four zones. The entering zone is a pre-heating section heated by hot air drawn from the radiant system. In this zone the work is pre-heated and high boiling volatile solvents are removed. The work then enters a zone of high energy concentration in which it is heated rapidly to baking temperature. The third zone is one of lower energy concentration in which the temperature reached in the second zone is maintained for any prescribed period of time. The work then enters the fourth zone, called the heat retention section, in which there are no lamps.

The heating cycle is completed in this section by the utilization of convected heat and the residual heat in the product itself. Actual oven design should take account of dimensions of the product; thermal characteristics of the material; temperature requirements of the process; time cycle requirements; method of handling the product; safety considerations; space limitations; existing investment to be utilized.

Among the advantages of radiant-convection heating equipment are the low initial and operating costs; the lack of a warm-up period; the greater coordination with other processes; its flexibility; the savings in floor space; consistency of results; and the fact that the operation of the oven can be observed at all times.

What Is Infra-Red?

There is little that is new or startling about the lamps generating infra-red energy. They differ only slightly from the common incandescent electric "light" bulbs we see everywhere. Infra-red lamps are, primarily ordinary "light" bulbs burned at reduced voltages.

It is a generally accepted theory that "light" is a vibration, in a conducting medium known as the ether. This theory also assumes that the different characteristics of light which we note, the different colors, the varied chemical and biological effects, are due to differences in the wave length of this vibratory phenomenon.

The popularity of radio has given us a conception of what is meant by wave length or frequency. It is known that the radio signal travels at the surprising speed of 300,000,000 meters (186,000

(Continued on Page 213)

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(Continued from Page 211)

miles) per second. A radio signal of 600 kilocycles (600,000 cycles) frequency will have a wave length of 500 meters. In other words the wave length in meters equals 300 million divided by the frequency.

Light waves travel at the same velocity as the radio wave, but with far greater frequency of vibration. For example, one of the red rays has a frequency of 400 million million per second. Obviously, such vibrations cannot be expressed in meters, or kilocycles, as radio waves.

The Swedish physicist, Angstrom, devised a scale, generally accepted as standard throughout the world, wherein the unit of measurement for the wave length of light is $\frac{1}{100,000,000}$ of a centimeter.

This is called the Angstrom Unit, sometimes abbreviated to "A.U." The visible range of the spectrum is from 4000 to 7800 A. U. The wave length of the red ray previously mentioned is 7500 A.U.

Infra-red emanations occur from 7800 to 120,000 A.U. Beyond these on the Angstrom scale are the radio short waves and broadcast bands.

Infra-red rays fall into two classifications —penetrating and non-penetrating. Penetrating "near" infra-red rays occur from 7800 A.U. to 14,000 A.U. Non-penetrating "far" infra-red rays from 14,000 to 120,000 A.U.

Lamps used in industrial processes utilize the visible penetrating red ray and the invisible penetrating "near" infra-red rays. The position in the spectrum of these combined rays is from 6500 A.U. to 14,000 A.U.

The most efficient source of radiant energy is one in which the electric power is converted to the greatest amount of infra-red rays within the efficient band.

Bibliography

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Wm. J. Miskella, Industrial Finishing—Feb. 1942.

Thomas P. Cusack, Jr., Proceedings, American Electroplaters Society, 1942, pp. 52-58.

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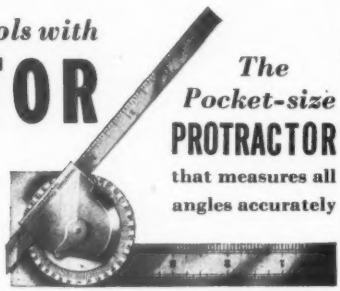

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SURFACE PLATES ARE *Masters*

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Flame Hardened Steel Dies

(Continued from Page 92)

Basically, flame hardening is a surface hardening and only a comparatively thin layer of the die is treated. It follows then, that if the die's surface is not in the proper condition to receive the treatment, the job will not be successful. Decarburized zones must be avoided and the components must have the requisite carbon content at the surface as well as underneath.

The surface of the die that is to be hardened must be scale-free. Scale retards quenching and it is impossible to get maximum hardness if it is present. Pits, blow holes, seams and laps are avoided for these imperfections often cause the hardened surface to crack during quenching.

Flame hardening, properly done, will not produce scaling or pitting. The hardened surface will be clean and smooth but the above mentioned precautions must be taken. It should be remembered too, that a temperature of 6300° F is applied at a distance of only one-fourth of an inch from the die's surface and if the operator should position the flame too close to it or apply the flame for too long a time, the result will be a seared or burned surface that is brittle and coarse. Another result is overhardening and surface checking.

As important as any of these precautions is the care in checking the steel in the die to be flame hardened. The die steel must be of a chemical composition to lend itself readily to hardening by flame. Carbon steels should have at least 0.35% carbon content and the best range is 0.40 to 0.70%. Steels with a higher carbon content may be successfully flame hardened but greater care has to be taken to prevent checking or cracking.

High alloy steels produce a very difficult surface for heating and quenching, and many of them must be avoided. In order to get uniformity, it is well for the shop to generate its own acetylene gas, thereby insuring a constant flow of pressure that cannot be obtained with the use of tubes. Moreover, in this war emergency tubes are a scarcity and with generators, positive control and the best results are assured.

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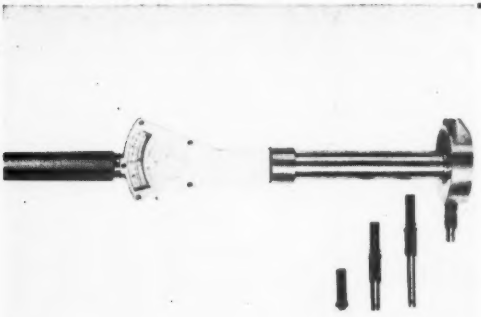

The Swedish Internal Indicator Gage is a reliable precision indicator especially designed for rapid, convenient and accurate measurement of internal diameters. Variations of as little as 0.00005" in size, out of round, and taper of bores can be quickly and accurately determined.

It is a light, easily handled instrument suitable for use on internal grinding, diamond boring or honing machines; or wherever a reliable method of accurately determining bore diameters is required; giving the operator positive control over the size and shape of bore. The use of this gage by machine operators, as well as for final inspection, increases production, reduces scrap, and produces a more uniform product.

The scale range is: Plus or minus 0.001" graduated to 0.0001" and minus 0.020" graduated to 0.001".

The plus or minus 0.001" range graduated to 0.0001" is used for checking the finished part. Scale divisions have ample width and variations of 0.00005" can be easily detected.

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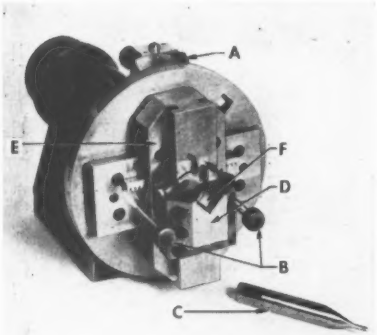
Radius Dresser Permits Dressing Wheel at Bottom

DESIGNED by Perfex engineers, the new tangent radius dresser pictured here now makes it possible to dress the wheel at the bottom where the grinding operations actually take place. This deviation from the usual method of dressing from the side causes the wheel dressings to be thrown directly into the dust collector rather than letting them fall onto the dresser itself.



An exclusive feature of the diamond mount construction plus the way in which the shank of the diamond tool is ground gives the Perfex dresser another distinct advantage. When the diamond shank is placed in position in the 90° Vee of the mount block it automatically puts the diamond point in perfect center.

By using a gage block setup, a direct reading from the base to the diamond can be obtained, thus guaranteeing a perfect radius. The Perfex dresser also permits the use of a sine bar to insure accuracy of angles that the ordinary vernier cannot calibrate. Moreover, no additional equipment is needed to dress a .050 radius to a full half circle.

Lettered parts in the accompanying illustration show (A) vernier, (B) stop pins, (C) dressing diamond, (D) radius adjustment, (E) tangent slide, (F) dressing tool mounting.

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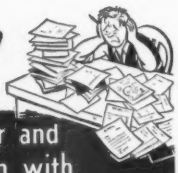

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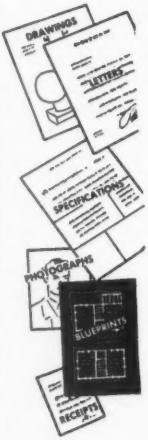

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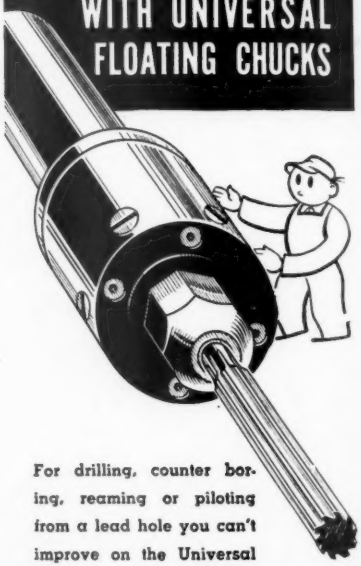

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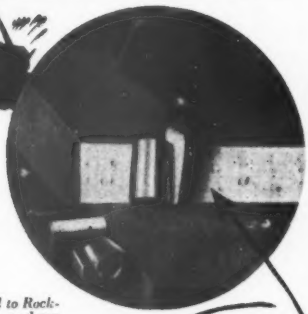

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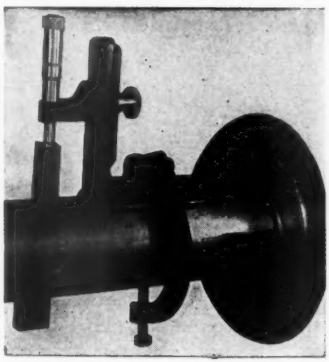

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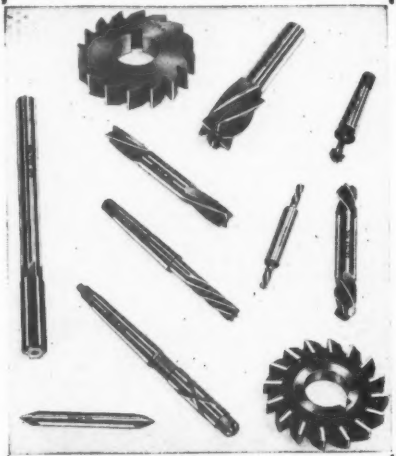

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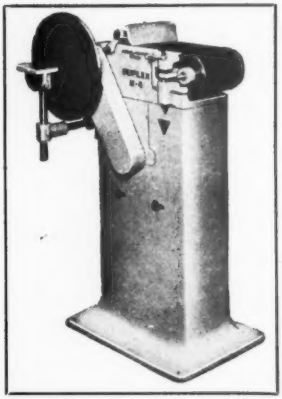

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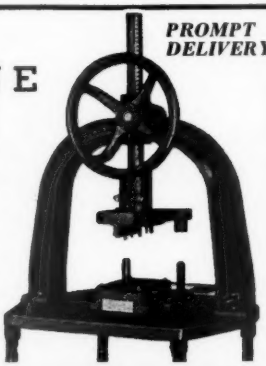

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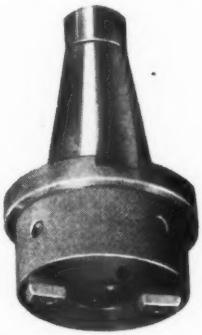
THE tool holder, when permanently installed on boring and milling machines, makes it possible to interchange adaptors in 5 minutes. The chuck and adaptors hold the tool so firmly that tools cannot pull out or change their position in any way during the cutting operation, insuring a new "high" in accuracy and a new "low" in spoilage.



The master holder fits new and old-type milling and boring machines having a spindle nose taper as follows: Nos. 10, 11, 12 and 13 Brown & Sharpe taper; Nos. 4, 5, 6 and 7 Morse taper; Nos. 40 and 50 National Standard taper.

Jobs for Women Engineers

Any tool that can be used on boring machines and milling machines, regardless of their nose taper, can be used with this holder. This includes boring bars, drill chucks, face mills, shell mills, end mills, boring chucks, and arbors.

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Milling Machine Adaptor Corporation, 1402 West Fort St., Detroit, Mich., will send further details and descriptive literature.

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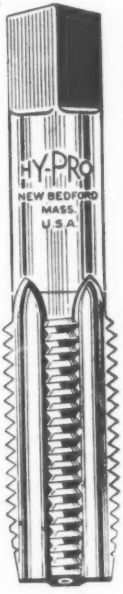

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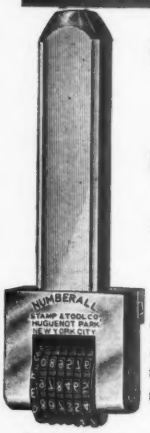

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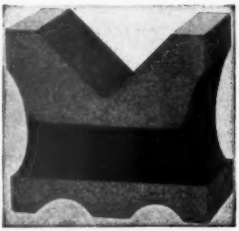

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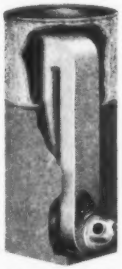

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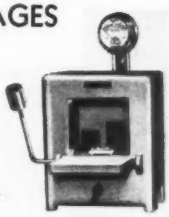

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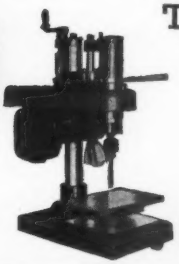

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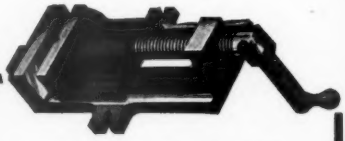

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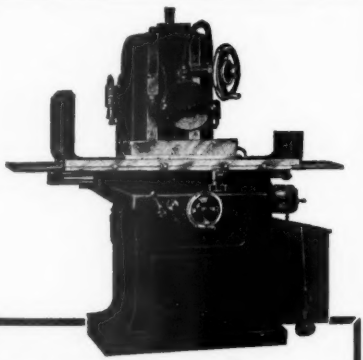

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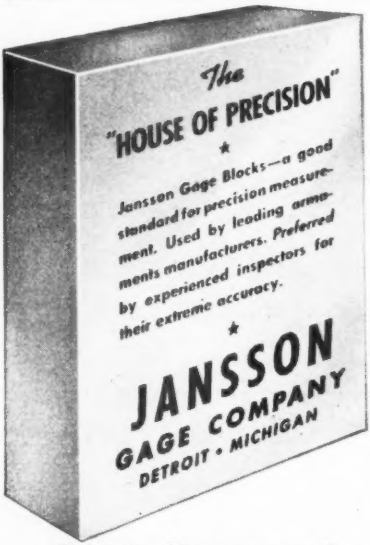
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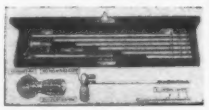

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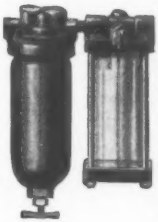

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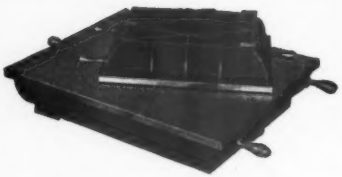

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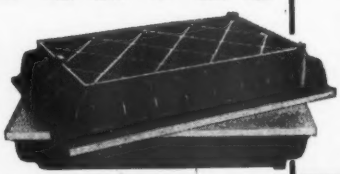

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The Lumidor Mechanic's Light was originally designed to illuminate the fuselage interiors of large aircraft during construction but the unit is being widely adapted to other industrial uses.

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Bracket for hanging and a hinged wire lamp guard are standard equipment. Twistlock fittings on the plug and receptacle are available at extra cost.

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SETTING-UP TOOLS

This is no time for machines to stand idle, while good tool makers rummage through the scrap heap for setting-up materials or waste vauable time fashioning makeshift setting-up devices. Equip all planers, shapers, milling machines, drill presses and special machines with ARMSTRONG SETTING-UP TOOLS—Planer Jacks, Bracing Jacks, "T"-Slot Bolts and Drop Forged Strap Clamps that reduce setting-up time to a minimum, hold work and jigs rigidly, prevent delays, accidents and spoilage and stand up for years.

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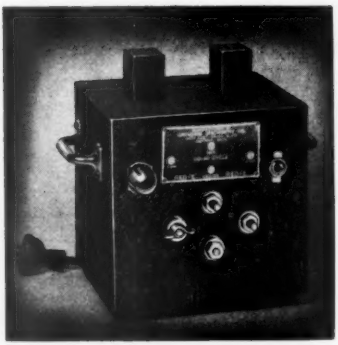
IMPROVED RED-"E"
ETCHER and DEMAGNETIZER
for Stellite and Steel



Special alloy tip etches uniformly. Extra heavy cord and asbestos-covered wire assure safe operation. Air cooled handle. SOLD ON 10 DAYS TRIAL. Special production demagnetizers also made to order.

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BROKEN TAPS

Quickly
Insert WALTON Tap Extractor and back out broken piece. No annealing—no drilling.

Easily
Tap Extractor and Tap Wrench are only tools needed.

Safely
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Every tool room needs this simple, portable, sturdy demagnetizer. Small parts passed through the powerful AMC field are instantly demagnetized. Large, flat surfaces can be demagnetized by sliding the device over the surface.

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Warehouses in All Principal Metal Working Centers

(Continued from Page 130)

heating is that of melting metals in relatively small charges. For this, a small crucible is used, preferably graphite, around which is wound a copper tube coil with an insulating layer of powdered alundum and asbestos, such as illustrated in Fig. 7. The charge is placed in the crucible, which can be in the form of iron or steel chips. Heating such a charge, weighing from 10 to 30 lbs., requires from 50 to 60 minutes. The action of the high frequency induction current causes agitation, on the order of a volcanic eruption, resulting in thorough mixing of the charge, especially desirable when alloys are used. A possibility for this use of high frequency heating is the making of small castings in plants where foundry facilities are lacking. Another use in this direction is the salvage of precious metals from floor sweepings, an idea already in practice at several plants. For the manufacture of small centrifugal castings, where small heats are required, induction heating has also proven of value.

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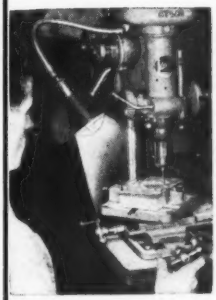

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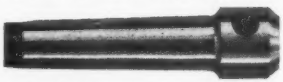
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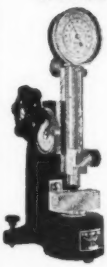

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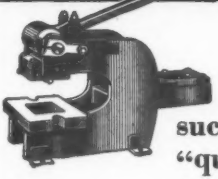

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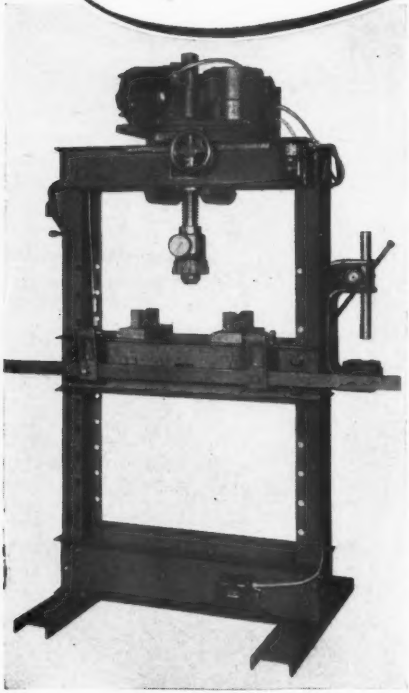

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DON E. ROOT

AS a number of readers already know, Assistant Editor Charles H. Haynes is now Pvt. Haynes of The United States Army. He has joined our publisher, George Huebner, a Smaller War Plants Corporation administrator, and our former Assistant Editor, Lieutenant Colonel Paul L. Reed, in a leave of absence. Pvt. Haynes, who is co-author of the unusually popular Training for Victory series, is located at Camp Joseph T. Robinson, Ft. Smith, Arkansas, and already displays a medal for excellency in marksmanship.

* * *

Our contemporary, *Time* magazine, reports in their May 10 issue that the United States Machine Tool Industry has an unusually gloomy outlook for the Post-War Period. In view of the fact that in the prosperous twenties the "sound value" of all machine tools was around 750 million dollars and at the end of this year the value will be around four billion dollars, this outlook can be appreciated. Joseph L. Trecker, vice president of Kearney & Trecker Corporation, added up all of the facts and then came to the conclusion that the industry's wartime business will stay at four or five times its peacetime production. His reasons: Inadequate, manpower wasting equipment will be replaced as the capacity to make it is freed from more pressing work; worn-out tools will boom the replacement business; new weapons, new military strategy will call for new tools (e.g., a tank making tool is no good if you want to make a "Bazooka" gun). Mr. Trecker further denies that war tools will be of much value for producing the dream cars, washing machines and refrigerators of the future. He believes that the tooling industry will be the indispensable base of a Post-War Consumers' Goods Market. His advice to other machine tool builders seems quite sound to us: "The future of the machine tool industry is no blacker than the individual abilities of its members will allow it to be."

* * *

Many executives who have been to Washington during these war days will appreciate this little analysis of the seven ages of a Dollar-A-Year man:

He's hired.
He's admired.
He's inspired.
He's mired.
He's tired.
He's fired.
He's retired.

* * *

The efforts of the WPB to conserve paper are having their effect in magazines through smaller trim sizes, lighter weight paper stock and condensed editorial material. Our first efforts in this direction were to concentrate editorial material on tooling and production "know-how". Result, the last issue carried one of the largest editorial sections of any magazine in the technical field. . . a total of 91 pages. Numerous reader comments have certainly encouraged us. One reader recently asked to have his subscription entered for the *remodeled* Tool & Die Journal.

* * *

According to recognized aero-technical tests, the bumble bee cannot fly because the size, shape and weight of his body compared to the total wing area makes his flying absolutely impossible—but the bumble bee does not know this, so he goes ahead and flies anyway. Moral: the only difference between the difficult and the impossible is that the impossible takes a little longer.

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THE Cleveland No. 1½ HORIZONTAL PRODUCTION MILLING MACHINE...

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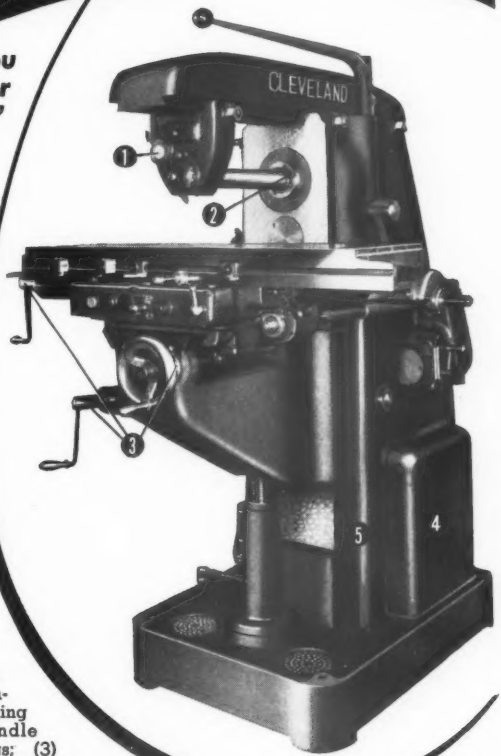
"You asked for this one, too"



● **Production** is the big word. The Cleveland No. 1½ Horizontal *Production* Milling Machine has a flexibility exemplified by its table design. The table can be set for full automatic cycle, giving rapid approach and feed, with rapid return from either direction continuously, or it can be arranged to stop at the end of the cycle. Using a fixture at each end provides continuous operation, one part being loaded while a second part is being milled.

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Five features (see figures on machine) suggest thoroughgoing construction: (1) self-oiling outboard support; (2) spindle mounted on Timken bearings; (3) lead screws also Timken-mounted; (4) housed electric panel; (5) rigid column.

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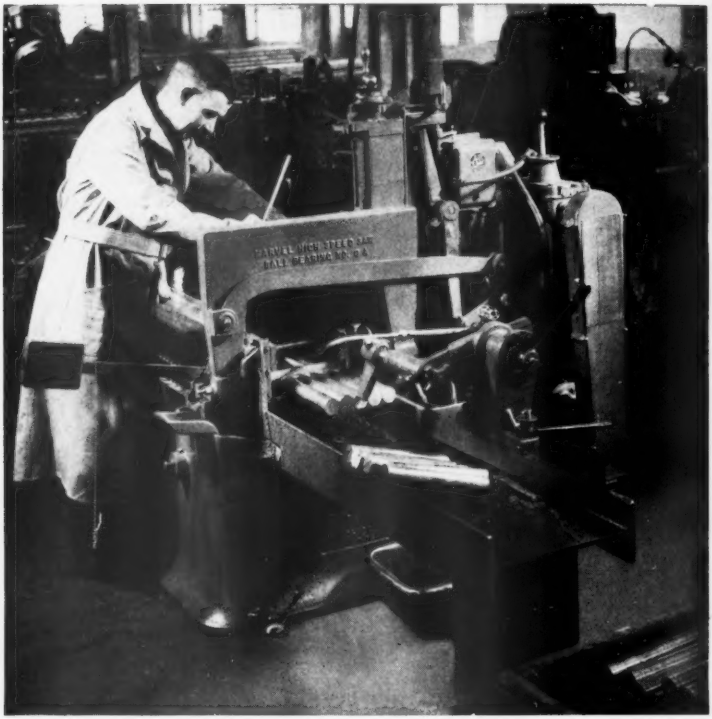

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